CIRCULATION OF THIS ISSUE OVER 225,000 COPIES

RADIO NEWS

REG. U.S. PAT. OFF.

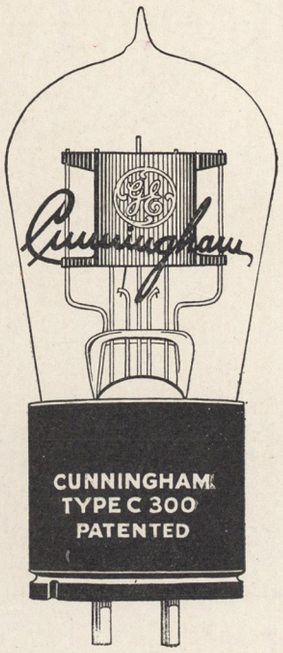
25 Cents
February
1923

Over 175 Illustrations

Edited by H. GERNSBACK

THE 100% WIRELESS MAGAZINE

CIRCULATION LARGER THAN ANY OTHER PUBLICATION



AMPLIFIES AS IT DETECTS

Cunningham tubes

Give Clearest Reception

Cunningham Tubes used in any standard receiving set will enable you and your friends to listen to news reports at breakfast, stock market quotations at lunch, and in the evening sit in your comfortable living-room by the fireside and enjoy the finest music and entertainment of the day.

Send 5c for new 32-page Cunningham Tube catalog, containing detailed instruction for the operation of Cunningham Tubes as well as numerous circuit diagrams and graphic illustrations of tube action.

The Cunningham Technical Bureau is at your Service. Address your problems to Dept. R.

Home Office:—
248 First Street
San Francisco, Calif.

E. T. Cunningham

Eastern Representatives:—
154 West Lake Street
Chicago, Illinois

Patent Notice

Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08 and others issued and pending. Licensed only for amateur or experimental uses in radio communication. Any other use will be an infringement.

TYPE C-300
Super-Sensitive
DETECTOR
$5.00

TYPE C-301
Distortionless
AMPLIFIER
$6.50

The trade mark GE is the guarantee of these quality tubes. Each tube is built to most rigid specifications.

$6.00 2000 Ohm
$7.50 3000 Ohm

Their Deep, Natural-Voiced Pitch Is Rapidly Selling Thousands

ACTUALLY—thousands are being snapped up on the strength of their pleasing voice tone and keen sensitiveness. The same hair-line refinement of design which for over eleven years has been so sharply pronounced in hundreds of Basco electrical units, here again shows itself in these skillfully constructed

BASCO RADIO Head Phones

"Hear" More *and* Cost Less

They are built *right,* pitched *right* and priced *right.* Close examination is convincing proof. They embody every high priced quality—perfect balance, clear, scratchless reproduction. Coils encased in aluminum shell—light weight, easy on the head. Employ solid horse shoe magnet—no laminations. Bus-bar connections, no loose hair-like wires.

Light, extra sensitive diaphragm, set to thousandths-of-an-inch accuracy from magnet poles. Clean cut, rugged design throughout. Compare them with any other head set—irrespective of price—then you'll be convinced they're what you want. Ask your dealer to show you Basco Head Phones. If he hasn't them, write us direct.

Put up in attractive orange and black cartons

We also make the Basco Radio Frequency Transformer, Vernier and plain Rheostat, Variable Air Condensers, Tube Socket, Dials and a Complete Crystal Outfit.

Jobbers and Dealers! Write for our exceptional discount proposition, and name of our nearest factory representative.

Briggs & Stratton Co.

Milwaukee — A BASCO PRODUCT — Wisconsin

RADIO NEWS

CONTENTS

VOL. 4 FOR FEBRUARY No. 8

	Page
Editorial ..... By H. Gernsback	1439
The First High Power Broadcasting Station in Havana, Cuba ..... By Ulpiano Muniz	1440
Broadcasting First Presidential Message to Congress ..... By S. R. Winters	1441
Giving the Whole Town a Radio Concert By Armstrong Perry	1442
Get Into the Code Work.. By Roy A. Anderson	1442
Linking the World's Farms by Radio By J. Farrell	1443
Keeping the Public Sold on Radio By Armstrong Perry	1444
Secrecy in Radio Communication By J. O. Carr	1445
On the Transmission of Waves By Sir Oliver Lodge	1446
Electron, Electric Waves and Wireless Telephony ..... By Dr. J. A. Fleming, F. R. S.	1447
Results of $500 Prize Contest "Who Will Save the Radio Amateur" ..... By H. Gernsback	1450
Our Popularizing Radio Scheme	1452
Super-Regenerative Amplification By William M. Smith	1454
The Reflex Circuit ..... By J. L. Goldsman	1455
Alkali Vapor Detector Tubes By Hugh A. Brown and Charles T. Knipp	1456
Radio Frequency Measurements By L. R. Felder	1457
Radio Control ..... By Major Raymond Philips	1458
The Ayes Have It ..... By Jack Bront	1460
Damping: Its Meaning, Causes and Effects in Radio ..... By Louis Frank	1461
Radio Frequency Amplification By John M. Avery	1462
Constructive Criticism on Phone Design By John Depew	1464
QST de MSU ..... By C. A. Reberger	1465
Mr. and Mrs. Brownlee Hold Hands By Ellis Parker Butler	1468
Who's Who in Radio ..... W. C. White	1469
A Method of Eliminating the Carrier Wave in Radio Telephony ..... By R. Heather	1469
With the Amateurs	1470
5HB Makes Radio History ..... By E. T. Jones	1472
New DX Records set by 6ZY at Honolulu, Hawaii	1473
How Amateurs Can Serve	1473
A Universal Receiver ..... By Louis J. Gallo	1474
Form Wound Coils ..... By S. E. Watson	1475
Design of a Portable Short Wave Radio Wavemeter	1476
A Five Watt Telephone and Modulated C.W. Transmitter ..... By Jesse Marsten	1477
Correspondence from Readers	1479
Awards of the $50 Wrinkle Contest	1480
Practical Hints for Amateur Constructors	1481
Radio Digest	1482
New Radio Patents	1483
Radio News Laboratories	1484
Radio Humor	1486
Club Gossip	1487
New Radio Legislation is Needed By Carl Butman	1487
With the Sea-Going Op's	1488
"1-Want-To-Know"	1489

Index to Advertisers 1594

RADIO NEWS is published on the 25th of each month. There are 12 numbers per year. Subscription price is $2.50 a year in U. S. and possessions. Canada and foreign countries, $3.00 a year. U. S. coin as well as U. S. Stamps accepted (no foreign coins or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., INC. If you should change your address notify us promptly, in order that copies be not miscarried or lost. No copies sent after expiration.

All communications and contributions to this journal should be addressed to Editor, RADIO NEWS, 842 Jamaica Avenue, Jamaica, New York; or 53 Park Place, New York, N. Y. Unaccepted contributions cannot be returned unless full postage has been included. All accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

RADIO NEWS. Monthly. Entered as second-class matter at the Post Office at Jamaica, N. Y., under the act of March 3, 1897. Title registered U. S. Patent Office.

Copyright, 1921, by E. P. Co., Inc., New York. The Experimenter Publishing Co., 53 Park Place, N. Y. The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.

RADIO NEWS is for sale at all newsstands in the United States and Canada; also at The International News Co., Ltd., Bream's Building, London E. C. 4, England, and at Brentano's 37 Avenue de l'Opera, Paris.

General Advertising Dept., 53 Park Place, New York City. Western Advertising Representatives, Finucan & McClure, 720 Cass Street, Chicago, Ill. Kansas City Representative, Geo. F. Dillon, Republic Bldg., Kansas City, Mo. Pacific Coast Advertising Representatives, A. J. Norris Hill Co., Hearst Bldg., San Francisco, Cal.

Published by EXPERIMENTER PUBLISHING CO., INC.,
Publishers of "Radio News," "Science and Invention" and "Practical Electrics."
Publication Office: Jamaica, N. Y. Editorial and General Offices: 53 Park Place, New York City
H. GERNSBACK, President S. GERNSBACK, Treasurer R. W. DEMOTT, Secretary

"The wise man looks into space,
and knows there is no limit to dimension."
said Chuang Tzu.
The wise Radioist bridges the greatest
distances with a

Grebe Receiver.

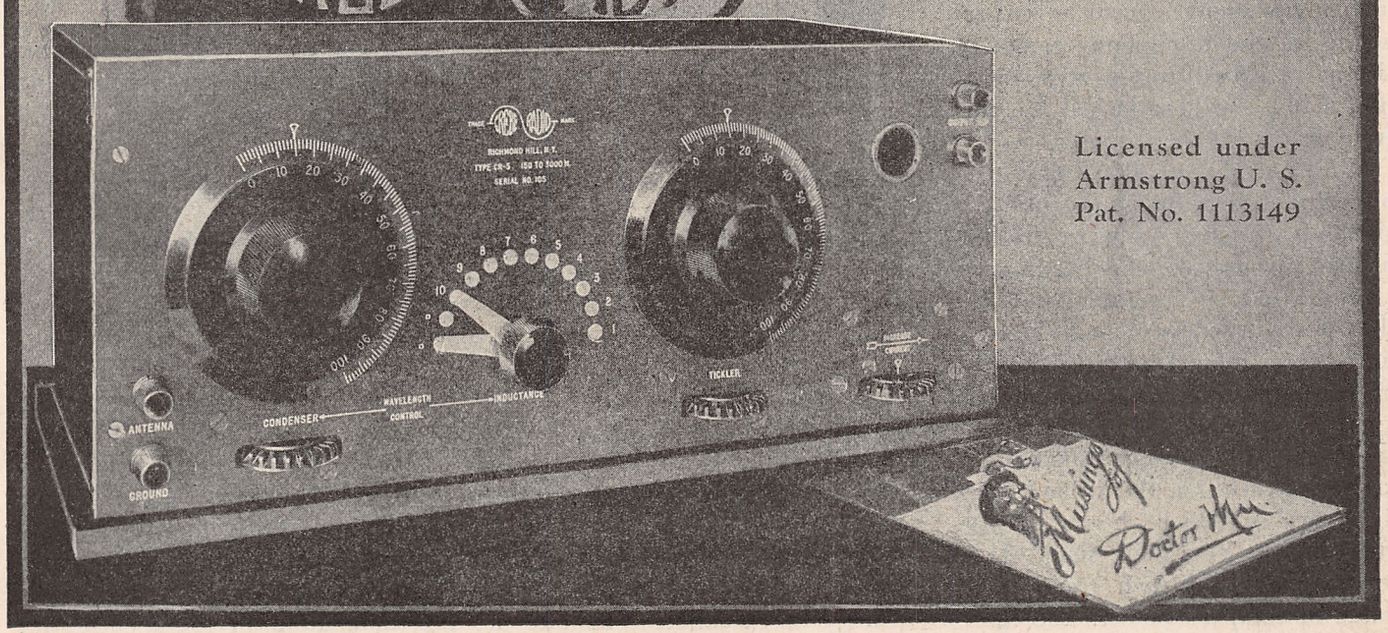
Doctor Mu.

A LONG RECORD of unequalled performance has won for the Grebe Receiver the unqualified endorsement of all good dealers.

"Musings of Doctor Mu"—the story of the development of the Perfect Receiver, free upon request.

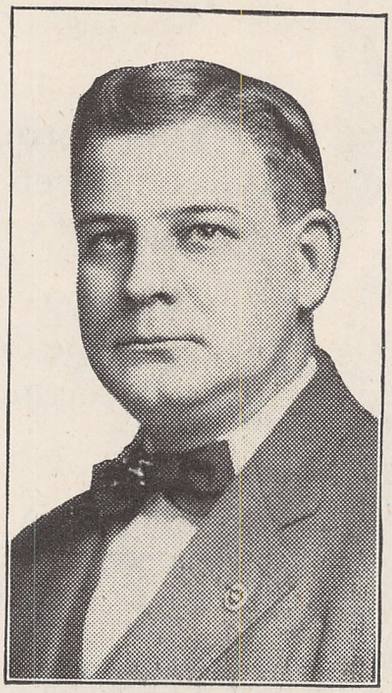
GREBE RADIO

A. H. GREBE & CO.
INCORPORATED
RICHMOND HILL, N. Y.



Licensed under
Armstrong U. S.
Pat. No. 1113149

The Progress of Chiropractic



By JAMES G. GREGGERSON, D. C.
National Lecturer for The Universal Chiropractors Association, Davenport, Iowa.

IT IS a far cry from Franklin's kite to the electric lighting, transportation and communicating systems of today, or from Watt's teakettle to the steam engines and ocean steamers of the present; yet it is no farther in either of these cases than it is from the experimental "push in the back" given to Harvey Lilliard, the deaf negro, by D. D. Palmer in 1895, to more than a hundred schools, over 20,000 practitioners and millions of converts to the science in 1922.

It requires performance to convert millions of people and to win place, power and prestige in a community infested with opposition, miseducation and prejudice. It requires more than bombast and profession to be acquitted by juries when prosecuted, and to inscribe laws favorable to Chiropractic on the statute books of state after state. Yet, in a quarter of a century, Chiropractic has done this; and, in addition, it has developed a science, art and philosophy all its own.

This performance becomes more amazing when one considers the personnel of the profession—a motley throng recruited from every walk of life, many of whom lacked the cultural graces of other professions.

With no other qualification in the majority of cases than an earnest desire to learn, students were enrolled in the Chiropractic schools and after six, nine, twelve or eighteen months, they were turned loose upon the public with a diploma, totally ignorant of business and its requirements, knowing nothing of how to conduct an office, and hardly even suspecting, let alone knowing, the value of the discovery of which they were the custodians. Yet, their small stock in trade was of such tremendous value in comparison with the value of therapeutic systems that, in spite of their handicaps, in spite of their shortcomings, and in spite of bungling applications of the principles of their science they have, collectively, and often individually won a tremendous success in competition with those who possessed all the qualifications they lacked.

Perhaps this can best be illustrated by the national statistics of the "flu" epidemic in 1918, which are as follows:

Medical doctors lost one out of every 16 patients.

Osteopaths, one out of every 127 patients.

Christian Scientists, one out of every 513 patients.

Chiropractors, one out of every 886 patients.

All of which simply proves that a gangplow in the hands of an ignorant peasant is far more efficient than a garden spade in the hands of the brightest, most learned and cultured gentleman in the world.

A brief survey of the discovery and growth of this science may prove illuminating.

D. D. Palmer, while giving a deaf negro named Harvey Lilliard a magnetic treatment, noted a lump on his back and pushed on the lump and the hearing returned. Impressed with the results obtained in this case, he examined the spines of all his patients for irregularities, and experimented with adjusting them. The results were that an astonishing percentage of so-called chronic and incurable cases recovered. He studied some, but being old and tired and pretty well satisfied with his results himself, he thought of transmitting the discovery to his son and of keeping it a family secret. But he reckoned without that son who, when he became possessed of the secret, wanted to establish a school and give the discovery to the world.

The son was young, energetic, expansive and visionary. He was attuned to the infinite, and the "cosmic urge" expressed through him a boundless physical, mental and spiritual energy which was shortly reinforced by the head, heart and hand of a poem of womanhood, and together they established the first Chiropractic school; together they faced the questions; and together they have worked out the science, art and philosophy of Chiropractic.

The disappearance of disease by adjusting the vertebrae of the spine was just as much of a mystery to them at that time as it is to you now. There was then—and there is now—no explanation in therapeutics for the results obtained. In the symptomatology of every medical college the etiology, or cause, of practically

every disease is "unknown." Some of the questions arising were: What vertebrae should be adjusted for blindness, deafness, insanity, paralysis, etc., and how can they best be adjusted; and what connection exists between a certain vertebra of the spine and the stomach, lungs, liver, kidneys, etc.? No medical book on earth gave an explanation; and in the endeavor to answer these questions the female partner went to Chicago to study anatomy, and eventually developed into the best woman anatomist in the world.

While anatomists described a brain and nerve system, and practically every religion taught existence of a soul or animating principle as a fundamental religious fact, it had not occurred to any of the earth's educated classes that the brain and nerve system so minutely described in their anatomies was the mechanism used by the intelligent, animating principle or power (Innate Intelligence) to coordinate the functions of the body, and that this mechanism (brain, and nerve system) would not function normally when it was impaired by the pressure of a harder tissue. In the study of the anatomy of the spine this man and woman found the answer to their question.

The spine is composed of movable segments (vertebrae) between which the spinal nerves can and do become slightly misaligned, thereby pinching the nerves, one of whose functions it is to carry the coordinating impulses from the animating principle (Innate Intelligence) to every tissue and cell in the body. When a nerve leading to any tissue in the body becomes impaired, the tissue supplied by that nerve does not receive the proper mental impulse, and as a result it does not work in harmony with the rest of the organism. It is then what we call diseased, which means without ease.

When the relation of the spine to disease became clear, many puzzling questions were answered and a philosophy reconciling the facts of religion and anatomy was produced.

In their clinic, by observation and experience, they found where to adjust to reach various organs and tissues of the body, and the connection between the vertebrae and all other parts of the body became clear as day. The task is not yet completed. There is still much that is not known, but during all these years of toil and thought they gave as they received to those who presented themselves as students. The first school course was brief, for they had little to give; but as the facts were gathered and classified, the school term grew in length until today the standard of all reputable schools is a three-year resident course, of six months to the school year, with a one hundred percent daily attendance requirement.

Chiropractic is unique and distinct from every other method. Chiropractors do not treat, heal, or cure; they simply adjust the misaligned vertebrae of the spine with the hands, and the power within, which they call Innate Intelligence, does all the treating, healing or curing that is done. They know that what that power can not or will not do, cannot be done.

They do not concern themselves with diagnosis; for of what value is it to confer a name on a group of symptoms when all that is necessary is to be able to find which vertebra is out of alignment, and to have the ability to adjust it to its proper place?

In the lexicon of Chiropractic there are no incurable diseases, for chiropractors know that the power that built the body, that coordinates its functions, heals its wounds, mends its breaks and converts common food into flesh and blood, can and does cure every disease. This does not mean, however, that disease cannot progress to a point where it is incurable.

Ask Your Local

Chiropractor

For

"The Last Word"

They do not believe in dietetics, for they believe that "Innate Intelligence" can and will adapt the stomach to the diet much more easily and quickly than any dietitian can adapt a diet to the stomach.

They do not believe in vaccination and serum therapy, because they believe that the only antitoxin that is fit to be put into the blood stream is that which is made by the alchemist that converts common food into living flesh.

They do not believe that germs cause disease, because the results obtained by Chiropractic adjustments in the so-called germ diseases are completely at variance with the germ theory.

They do not believe in drugs, for they cannot reason how a decoction that will make a well person sick can make a sick person well.

They do not believe in health springs or mineral waters or pink pills, for their science teaches that "all power cometh from within."

For the adjustment of the misaligned vertebra they use nothing but their hands and they regard those who use vibrators, stretching machines, therapeutic lamps, et cetera, as incompetents who are prostituting the science for gain — professional mercenaries.

Neither do they assist Nature. They know that the power that flung the sun and stars in space and makes the oceans ebb and flow, doesn't require assistance.

They ask nothing of state and national governments but a fair field and no favors. They ask but the opportunity to prove to all that the world that the cause of disease has been found. Those who would strangle this growing profession by law, would rob all posterity of a boon; therefore, they ask that in each state there shall be a Chiropractic state examining board to pass upon the qualifications of those who would practice the science. A medical board can no more pass upon the qualifications of a chiropractor than a chiropractor can pass upon the qualifications of an M. D., because the fundamental ideas of each system are antipodal to the other.

Chiropractors face one gigantic problem and that is the problem of keeping the profession clean of incompetents—of the rag-tag and bobtail from other professions who have no knowledge of the science, art or philosophy of Chiropractic and who simply buy a diploma from a "diploma mill" or change their business cards to "Chiropractor."

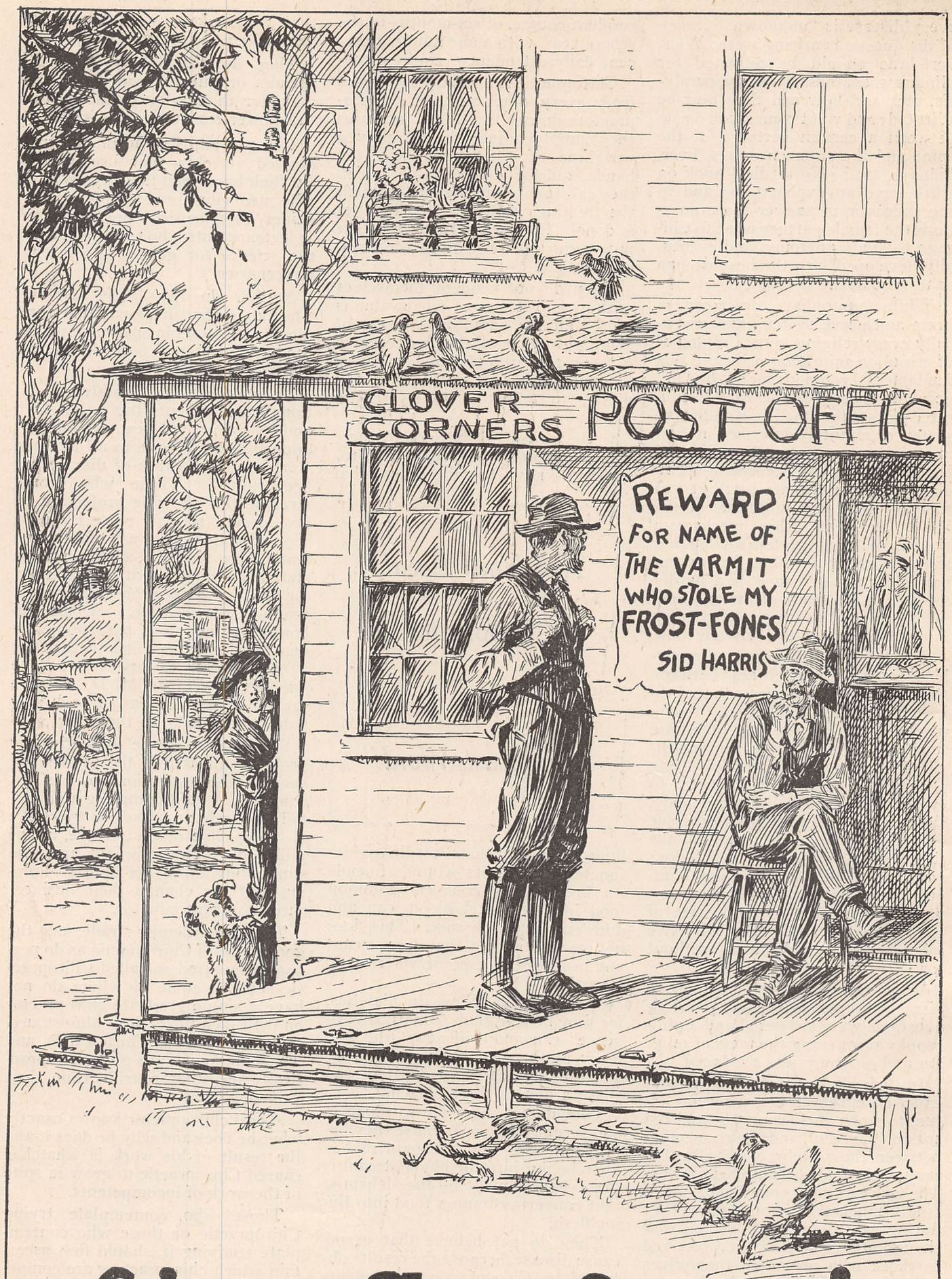
These gentlemen trade on the good name of Chiropractic as do perhaps a hundred so-called Chiropractic schools, some of whom do not have a single graduate chiropractor on their faculties; where almost anything is taught as Chiropractic, and where diplomas are given for practically no other consideration than a financial one.

A real chiropractor knows exactly what he does and why he does it and the result of his work is what has caused Chiropractic to grow in spite of the work of incompetents.

Those who contemplate trying Chiropractic or those who contemplate studying it, should first ascertain which chiropractors are competent and which schools really teach Chiropractic.

This information may be obtained from the Universal Chiropractors Association, Davenport, Iowa.

Advertisement



Crime at Clover Corners!

RADIO NEWS

H. GERNSBACK—Editor and Publisher
ROBERT E. LACAULT—Associate Editor

EDITORIAL AND GENERAL OFFICES, 53 PARK PLACE, NEW YORK

Vol. 4 FEBRUARY, 1923 No. 8

Radio in 1923

THE year just closed has been one of the memorable ones, for radio, not only in the United States, but in nearly all civilized countries. Radio seems to have come into its own in 1922. Even the most sanguine and the fondest well-wishers of radio never foresaw the tremendous interest that was displayed by the public in all matters radio, in the year just passed. As we have stated before, in these columns, the boom in radio was only to be compared with the boom times of the Texas Oil Fields. In one short year the radio telephone broadcasting stations, that numbered less than six in the United States, increased to almost six hundred at the end of 1922. Every state of the union, with one exception, has its broadcasting stations, sending out regular schedules of entertainments.

As for the advance of the art during 1922, it has been very material, but no very great scientific discoveries in radio have been made. The announcement of Major Armstrong's Super-Regenerative Circuit, by means of which it is possible to receive from over hundreds of miles, using only a single vacuum tube and a loop, was one of the achievements of the art. Aside from this, there were no great radio discoveries, and if there have been any, they have been more theoretical than practical. It is true that a great many new radio patents have been taken out during 1922, but it is as yet too early to say whether any of these will prove epoch-making or not. In transmission, a great advance has been made, all sending, and particularly broadcasting, sets having been improved greatly during the year.

Another milestone in radio for the year was the advent of the high power vacuum tubes, one of these tubes being able to handle no less than 1,000 kilowatts! We are safe in saying that this tube spells the doom of our present high frequency alternators used heretofore in hurling radio waves across land and oceans. Indeed, the best one of the type, the Alexanderson alternator, is already doomed, and will be obsolete in a few years.

The year just closed has been particularly interesting from the point of view of the public. Inventions and developments in radio were stifled more or less on account of this radio boom. It seemed as if everyone, whether he knew much about radio or not, and providing he had a few thousand dollars to invest, promptly embarked upon some radio enterprise or other, with the sole idea of making money out of the game. Naturally, under such conditions, the engineers did not have much time left for research work. It was a case of getting out some radio equipment somehow, at any price. As long as the apparatus could be assembled there was a ready sale for every radio article, good or bad, in the late winter and early spring of 1922.

We stated editorially in our March, 1922 issue—the beginning of the boom—as follows:

> "Tremendous efforts are being made by manufacturers to meet the situation, and with all the new capital being poured into the business, we estimate that within six months at the most the supply will exceed he demand. In other words, everyone, unless he buys carefully, will be overstocked, and the usual hardships will follow. This not only holds true for the dealer who will find himself loaded with material on his shelves that he cannot move rapidly, but for the small manufacturer as well, who will have all his money tied up in merchandise for which the sale is not as brisk. We shall then witness the next cycle, price cutting, when real competition will begin in earnest."

As will be seen, every word of this prediction came true. There have been tremendous failures in radio, and it is safe to say that less than one-half of the concerns that embarked as manufacturers into the radio industry are alive now. Of the 50 per cent that are still going, 25 per cent of these newcomers are finding themselves in financial straits at the present time of writing.

The answer is two-fold: Over-production on the one hand—exceedingly poor apparatus, made to sell and not to work, on the other hand. In many cases the public was caught unawares and bought radio material that proved a detriment to the entire industry. In many cases the public began to think that radio was a swindle, due to such poor equipment that sold at high prices and gave no results.

What about the future? What will 1923 *spell to radio?*

There is no question that during the coming year the research in radio will once more become important with our engineers, and that a great many important improvements in radio inventions will be made during this year. For one thing, we are quite certain that the day of poor equipment has gone for good. The radio industry is becoming exceedingly wary of poorly-built instruments, and will have none of it. *We predict that only those concerns that turn out first class material will survive in* 1923. Slowly our manufacturers are beginning to see that radio is more of an art, than a manufacturing proposition. *Precision and accuracy* are the words that every manufacturer should take to heart for 1923.

Whereas we used to be content with wooden boxes and fibre bases, the all-composition moulded instrument is coming into vogue more and more. The radio public wants something that stays put, that is not influenced by temperature changes, and that will not come apart of its own accord.

We predict also for 1923 that radio frequency amplification will be used much more generally than it is now. Radio frequency does not give rise so much to distortion as do regenerative circuits. This is said with no idea of discouraging people from experimenting or buying outfits which have regenerative circuits, but rather to urge the manufacturers to so improve their regenerative outfits, that distortion is done away with.

In 1923 we shall, no doubt, see the single control outfit. The public at large, particularly the lay public, wants an outfit with a single adjusting knob. The average layman does not cherish the idea of six or seven knobs and dials, which are apt to confuse him, and lead him nowhere, for the reason that he does not know how to get results from an otherwise good outfit. Every woman or housewife knows how to operate a phonograph. How many, out of a hundred, know how to operate a vacuum tube set? The percentage is exceedingly small. Our manufacturers who wish to steal a lap on their competitors should work along these very profitable lines.

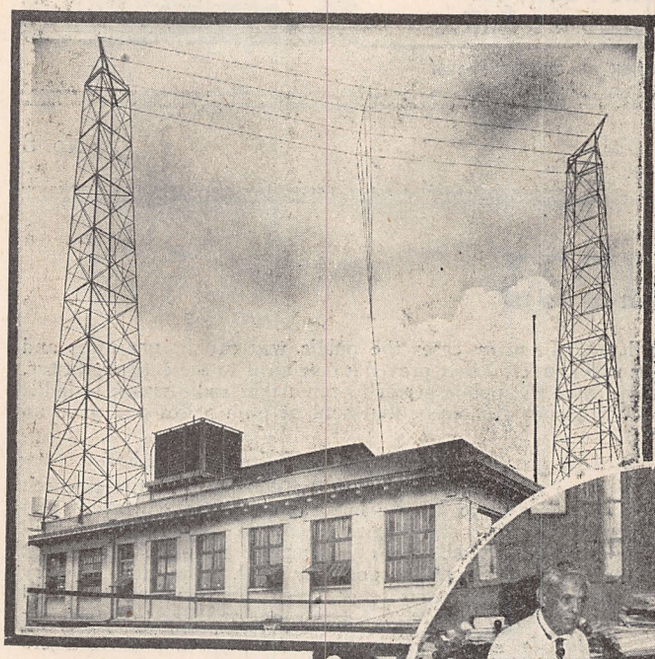
The next great improvement needed in 1923 is the outfit or appliance that will do away with interference. Whether it is the vacuum tube or crystal set, there is entirely too much interference now. Only an expert can tune out the unwanted station. With a four- or five-tube receiver it is possible to pick up stations several thousand miles distant. Within such a radius are three or four hundred broadcasting stations. Any evening, between 8 and 10 o'clock, a great majority of these stations is operating. What chance, then, has the average layman to pick out any of these stations and tune to any one he wants? The chances are mighty slim that he can do it. As a rule, with the present outfits, there is horrible interference. Of course, a loop set will help greatly, but this is NOT the solution of the problem. There must be something in particular that we have as yet not learned, and somewhere, somehow, some genius will no doubt effect a satisfactory solution.

The next and most important improvement upon which our manufacturers should concentrate, is the loud talker. It is safe to say, and experts agree upon it, that one cause of the slump in 1922 was directly traceable to the abominable sounds emitted by nondescript loud talkers, which were not constructed upon either mechanical, electrical, or acoustic principles. 1923 will probably see a great change in our loud talkers. It is safe to say also that the loud talker, at the end of this year, will be a totally different appliance from what we have now. *We predict that it will not be of the horn type at all*, but that it will be constructed upon entirely different principles.

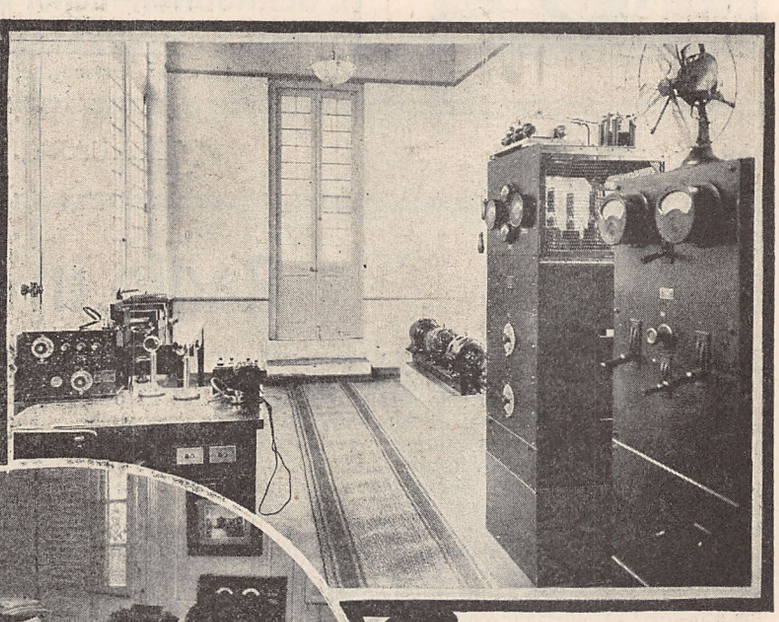
H. GERNSBACK.

The First High Power Broadcasting Station In Havana, Cuba

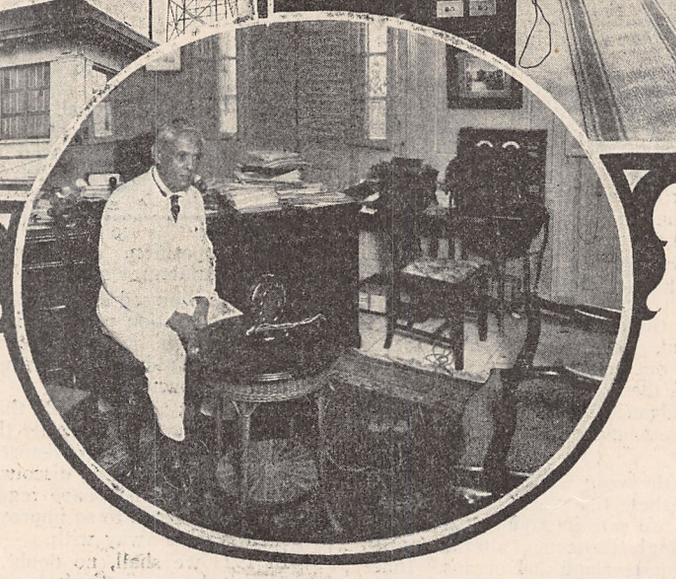
By ULPIANO MUNIZ*



The Massive Antenna System of Station PWX, Havana, Cuba. The Lattice Work Towers Extend 125 Ft. Into the Air.



A View of the Transmitting Room. On the Left is the Receiver While on the Right is the Control Panel and the 500 Watt Transmitter. The Motor-generator May Be Seen in the Background.



President Zayas Seated Before the Microphone of PWX Delivering the First Speech Broadcasted From That Station.

ON THE tenth of October, thus combining a patriotic commemoration of sacred memory to the Cuban people, President Alfredo Zayas, seated in his private office of the Presidential Palace, inaugurated the first high power radio telephone broadcasting station in Latin America directing a speech, full of warmth and enthusiasm, to the neighboring, friendly American nation.

This first program commenced at four o'clock in the afternoon with the National Hymn, executed by a renowned orchestra of Havana. Afterwards was broadcasted President Zayas' speech, followed by excellent musical selections by famous players of national reputation.

The writer had been invited by the Cuban Telephone Company, and after having heard a couple of musical numbers at the Palace, where a receiving set with loud speakers was installed for the benefit of the distinguished guests who came in, he went to the studio of this broadcasting station, the first to establish a regular schedule in all the Spanish speaking countries of America.

Through the amiability of Mr. C. Comas Bolfa, manager of the station, and personal attendance of Messrs. Wurm and Taylor, operators in charge, I was able to take photographs which represent various points of this wonderful station.

It is composed of three rooms, located on the second floor of the former Radio Corporation of Cuba's building, these rooms being nicely furnished by the owners in hopes of presenting a "unique" radiophone broadcasting station. They have surely succeeded.

In the first room are located the power plant and controlling switchboards, the Western Electric transmitter, and receiver with four stages of audio amplification, a monitor set of the same characteristics with a loud speaker and the input amplifying unit, directly connected with the microphones at the studio and the transmitter's speech amplifier.

The motor generator set is an "Esco" unit, composed of an alternating current motor driving two direct current generators. The first is used for delivering the plate voltage of the transmitting tubes, namely, 1,600 volts at 1.25 amperes. The other dynamo furnishes 14 volts and 30 amperes for the filaments, as well as the field excitation current of both generators, through a special winding employed for this purpose.

The terminals of this power plant are connected to a special switchboard, containing circuit breakers for the plate and filament circuits, a delayed action relay, requiring twenty seconds for successful operation, to open the transmitting circuits, should a destructive rush of currents pass to the tubes upon closing the plate circuit before the filaments.

This transmitter, under full power, broadcasting telephone service, is capable of delivering 17.5 amperes to the antenna system, an achievement to which we account the unusual range of this set, which on the first broadcast's program, reached points as far away as 3,000 miles in air line from Havana in all directions, according to records filed by the Cuban Telephone Company.

It operates on a wave-length of 400 meters, and on every Wednesday and Saturday evenings, from 8:00 to 10:30, Havana time, musical and special selections are broadcasted via the ether. The call letters are "PWX."

The receiving set is a special Western Electric type 2-C, with several amplifiers, wave-length range between 150 and 1,600 meters. It is connected through the relay switch just described to the four wire, 125' transmitting antenna. A monitor set of the same class, with three steps of audio amplification and Western Electric type 216-loud speaker, is used for watching over the modulation and output of the transmitter. This second receiver is hooked up to a separate, single wire antenna, 100 feet below the large sending one at right angles to same.

"We are now going to have the best musical programs for the benefit of listeners in," said Mr. Bolfa, "and I am sure this will be appreciated by all those who esteem the high cost of this special service. The Cuban Telephone Company in its desire to satisfy the public, after installing the submarine cable, which places Cuba in connection with the United States, offers to its clients this latest advancement of science, in the assurance of aiding to improve the educational status of our country.

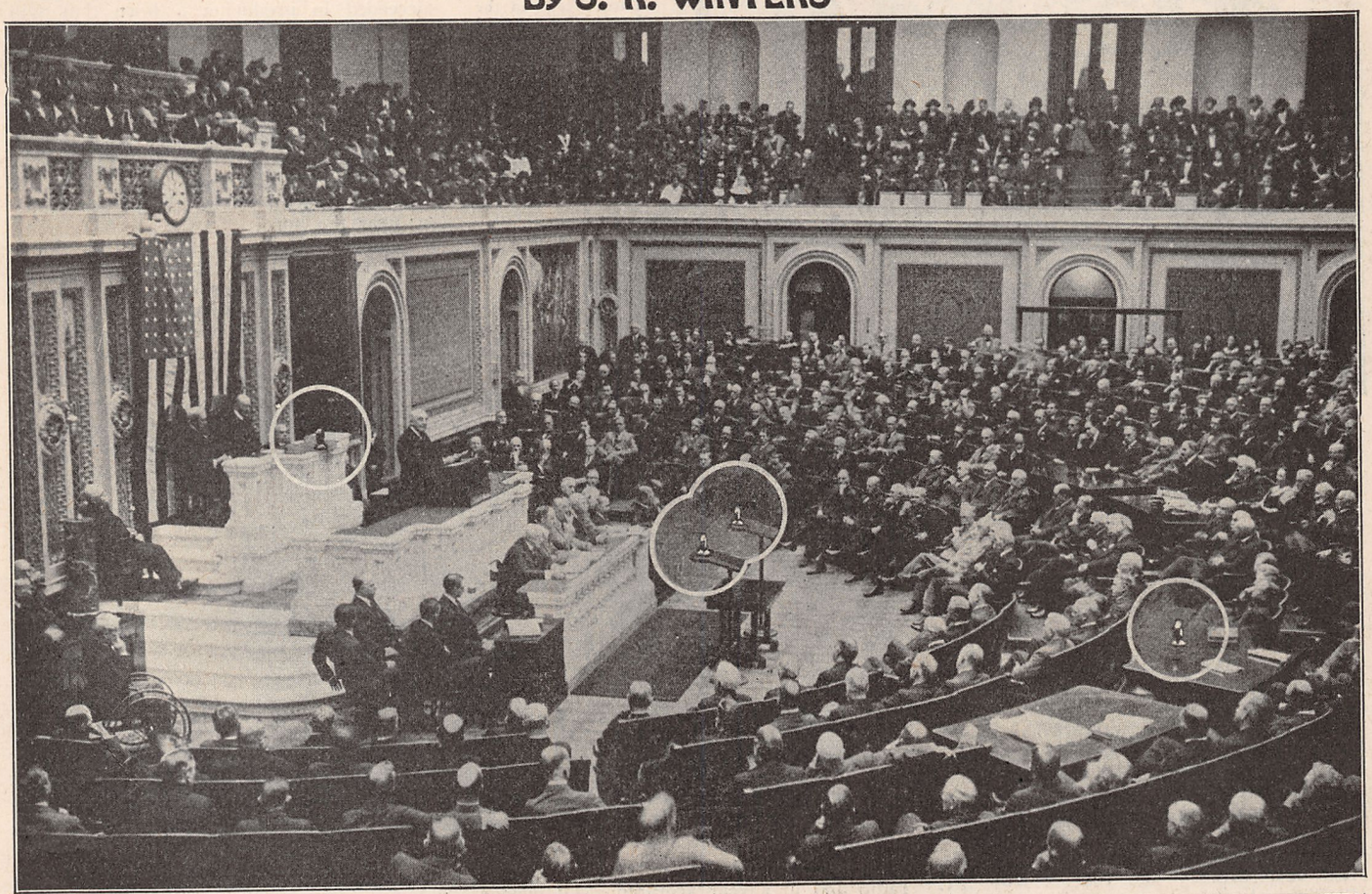
Mr. Comas Bolfa believes that everywhere the newest of all discoveries, radio telepheony, advances, and not only the education of the people is materially improved, but their worldly knowledge as well, for the best music that composers have ever produced, the most profound scientific lectures and literary addresses are within

(*Continued on page* 1593)

*Cuban correspondent of Radio News.

Broadcasting First Presidential Message To Congress

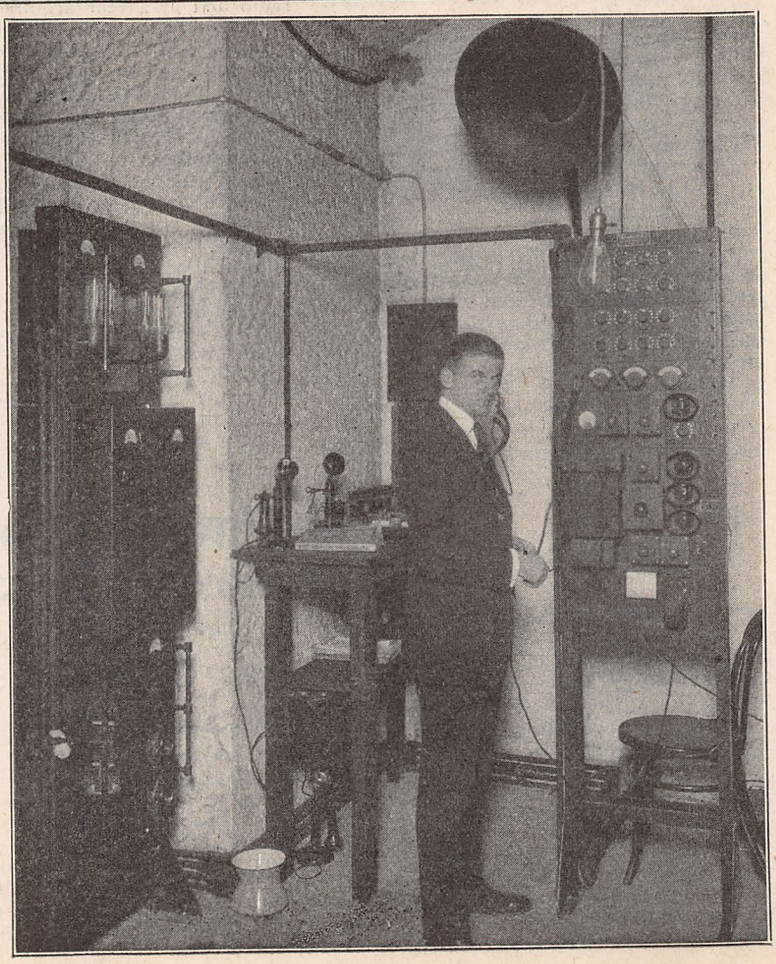
By S. R. WINTERS



WHEN President Warren G. Harding delivered his message to a joint assembly of the House of Representatives and Senate, on December 8, for the first time in the history of the sessions of the American Congress the utterances of a President of these United States were heard by an invisible audience by means of the radio telephone. His pungent remarks, "There are conditions relating to its (Eighteenth Constitutional Amendment) enforcement which savor of a nation-wide scandal" and "Agricultural ill fortune is a national ill fortune," were heard with a distinctness within a radius of approximately 200 miles of the National Capital as did the members of the Cabinet who occupied front seats in the House of Representatives. The radical departure of broacasting the deliverance of a President is epochal, and radio telephony demonstrated certain advantages over Morse telegraphy and Bell telephony as a means of communication. The vastness of the area covered within the twinkling of an eye is a peculiar virtue of this vehicle of intelligence.

The voice of President Harding on the state of the Union, as he specifically addressed the Fourth Session of the Sixty-Seventh Congress, was probably heard by the largest audience in the history of the world. The seating capacity of the House of Representatives was occupied to the point of overflowing, thus constituting his visible hearers. The invisible audience, it would be hazardous to attempt to name its numbers, was comprised of the thousands of owners of radio-telephone receiving outfits who were apprised of the deliverance of the message and those who had the inclination to "listen in." A microphone mounted on a pedestal, located about four feet from

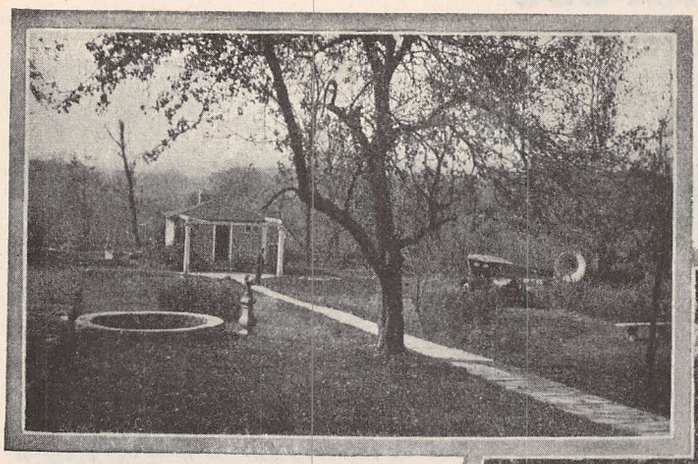
(*Continued on page* 1568)

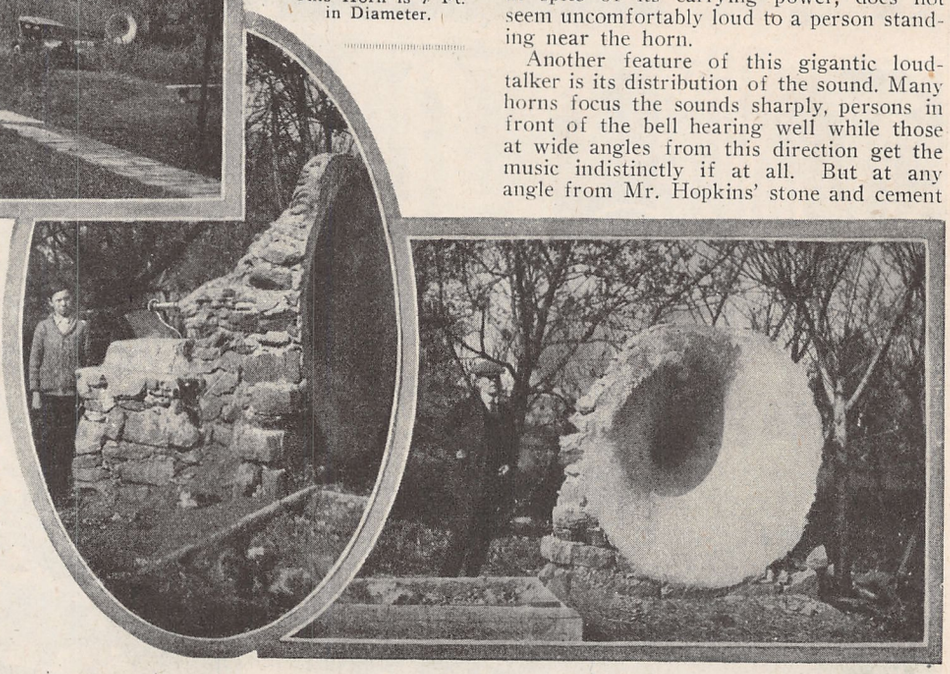


In the Picture Above, Showing President Harding Delivering His Message to Congress, May Be Seen Several Microphones, Out-Lined with White Circles, Which Were Installed at Various Places to Pick Up the Voice. On the Right is Shown the Amplifying Device Installed in the Cellar of the Capitol by the Western Electric Co. In Front of the Operator is a Speech Amplifier Composed of Four Tubes. The Speech, After Being Amplified by This Apparatus, Passes Into the Second Power Amplifier on the Left Side Panel Upon Which May Be Seen the Four 50-Watt Tubes on Top and at the Bottom, the Last Two Power Tubes of 250 Watts Each. From This Installation, the Voice is Carried Through Wires to the Loudspeakers Installed at Various Places and Also to the Navy Broadcasting Station, NOF.

Giving the Whole Town A Radio Concert

By ARMSTRONG PERRY





Three Views of the Large Cement and Stone Loudspeaker Built by Mr M. C. Hopkins of Washington, D. C. The Volume From This Speaker is Sufficient to Carry Sounds Clearly for a Distance of Two Miles. This Horn is 7 Ft. in Diameter.

IN Waterford, Virginia, there is a loud talker that gives the whole town a concert at one time, for it can be heard for two miles. It stands on the lawn at the edge of a little stream that flows past the lodge of M. C. Hopkins, an acoustic expert of Washington, D. C.

Mr. Hopkins is also President of the Cave Men's Club of America, which has explored scores of little known caverns in the Shenandoah Valley and elsewhere during the past twenty-seven years. One of these is George Washington's Masonic Cave in West Virginia. It is recorded in Howe's Virginia Historical Collections, published in 1849, that a party of Masons visted this cave in 1844 but between that year and 1922, when the Cave Men's Club explored and photographed the cavern, it seemed to have fallen into oblivion. Waterford is conveniently situated between Washington and some good cave country and that is why Mr. Hopkins selected it as a place to build his lodge. Around this artistic structure he built fish ponds, lagoons and islands. He rolls up from the national capitol in a big car every Saturday afternoon and, unless he starts on immediately after dinner for underground exploration, the people of the town are his guests at an evening concert and at church services brought in by radio on the Sabbath.

Being an expert on sound, Mr. Hopkins was far from satisfied with the loudspeakers in use when he first became interested in radio, a year and a half ago. He promptly brought to bear his long experience with phonograph horns and attacked the new and interesting problem. First he designed a radio horn. This tested out all right so far as acoustic properties were concerned but he could find no electrically operated diaphragms and attachments that would give good results. So he studied radio and in a year acquired a knowledge of the subject sufficient for his purpose.

He refused to be satisfied with any weak, distorted results. In fact he is never satisfied until he brings in a concert with greater volume and better quality than it had where it took place. Incredible as it may seem, those who hear his concerts declare that the piano, violin and vocal solos, and the choral and orchestral selections roll out from his seven-foot horn with a roundness and mellowness that no instrument or voice can equal without assistance.

Mr. Hopkins says that the results that he has obtained are due merely to control of the sound vibrations and that he has by no means reached the limit of what can be accomplished. He seems to be able to see in his mind's eye just what every sound ripple in the air is doing from the time the diaphragm at the little end of the horn starts it on its way until it finally breaks up and is dissipated in the atmosphere. He has succeeded in producing a horn that will carry sound to distances hitherto unknown because he knows how to shape it in order to project a wave that will retain its form for a considerable period of time. As long as the waves retain their form they are heard distinctly at a distance, as distinctly as at the mouth of the horn. The music, in spite of its carrying power, does not seem uncomfortably loud to a person standing near the horn.

Another feature of this gigantic loudtalker is its distribution of the sound. Many horns focus the sounds sharply, persons in front of the bell hearing well while those at wide angles from this direction get the music indistinctly if at all. But at any angle from Mr. Hopkins' stone and cement horn the listener gets the music in full volume.

Mr. Hopkins' idea may mean a new era in radio. The solitary listener with the phone clamped to his head was for a long time a sort of conventionalized symbol of radio. Since the advent of the broadcasting of voice and music and the invention of the loud-speaker, the popular conception of ideal radio has changed to that of a family group or indoor social gathering listening to a radio receiver as to a phonograph. With the big horn distributing music of superlative quality over a radius of two miles, radio becomes a community feature. A crowd of fifty thousand or more persons can hear a grand opera or an address by a famous man out-of-doors as easily as a family can hear the same thing around the library table. In Waterford some of the listeners gather on the lawn at the lodge but just as many sit on their own porches or get the music through an open window.

Get Into the Code Work

By ROY A. ANDERSON

CODE work interesting? We'll say so. You fellows new to the game have occasionally been known to scoff at the amateur who works in code—the fellow who, apparently, sees little in being able to listen (by radio) to a phonograph concert promulgated by some station a few miles away.

His feeling is obvious. He can go into the living room and play his own phonograph; then there is no static or any bothersome noises. On the other hand, though, I will venture to say that should McCormack sing, or should Kreisler play, there is a majority of amateurs who would be willing and even eager to listen.

So much for that; it has nothing to do with the code.

As a radiophone listener you are interested in anything novel, but will your interest hold? Decidedly not in this case. On the other hand, if you let the mysteries of radio captivate you it will be one thing that you will never regret.

At the present time there is what approaches an intense hatred between the average radiophone listener and the amateur. The amateur is warlike because of the unjust accusations of the radiophone listener and the latter, well-meaning it is true, is misled to believe the amateur is to blame. There have been a good many discussions on this question, and this is not another, not directly anyhow. Personally (being an amateur), I believe that the honest dyed-in-the-wool "ham" is the one in the right, but he is practically powerless because of his utter insignificance in round numbers as compared with the number of those captivated by this one new novelty, the novelty which will eventually become an important commercial pursuit, but not by virtue of the radiophone listener of today.

By way of bringing out my ideas, let us

(*Continued on page* 1560)

Heard But Not Seen

We are very pleased, indeed, to introduce to the radio public, the managing force of WOR, Bamberger's, Newark, New Jersey. The efficiency of the station (which has been heard in England) may be attributed to Mr. J. Popele the chief operator. The condition of the apparatus is such that "Pop" has little to do but watch the modulation meter and take an occasional glance to determine if the aerial is still where it should be. The voice of Mr. J. M. Barnett, one of the announcers, is very familiar. You now have the opportunity of viewing his general appearance. Miss J. E. Koewnig, manager of WOR, will always be remembered for her clear, soft voice. We wish she **were** on the air more often, though. Mrs. Egner makes the programs just so much more pleasing by her excellent playing.

Linking the World's Farms by Radio

By J. FARRELL

Thanks to radio, the farmer of today is now connected with the outside world.

HANS PFEFFER, a young Dutch farmer, cast a satisfied glance over eld of waving grain. The crop was in good condition; there would be an abundant harvest. But what of the wheat crop in other parts of the world, he thought. Here in the Argentine there would be an exportable surplus.

A bell tinkled indoors, and Hans adjusted a dial on his radio set.

"The world wheat crop is estimated at three billion bushels," the report came. Hans smiled. Wheat would be in demand.

In the United States, Jim Weller, a Kansas farmer, was also looking over his crop. He knew that large surplus production would break the market. Suddenly Mrs. Weller appeared in the doorway.

"O, Jim," she called, "I've just received a radio message that the world wheat crop is three billion bushels."

Jim smiled. Wheat would be in demand.

Millions of farmers all over the world had almost simultaneously received the message. The farm skies cleared. While the world crop of wheat was short the addition of storage supplies from the preceding season would effect an even balance between supply and demand. The world would be fed and at a price satisfactory to both producer and consumer.

Possibly the foregoing picture is a look too far into the future. Albeit, the United States Department of Agriculture is now

(*Continued on page* 1564)

Keeping the Public Sold on Radio

By ARMSTRONG PERRY

IT came all right, that slump that every radio man knew was inevitable. The worst of it is, it lingered on into the winter and in some localities the demand for radio apparatus threatens to become as permanently depressed as the current demand for daguerrotypes. What is the matter?

I cannot answer the question from the standpoint of manufacturers or dealers, though I have talked with many. The talk of makers and sellers of today goes into so many things besides the public's willingness or unwillingness to buy that the layman is soon hopelessly lost in technicalities of contracts, patents, discounts and other matters that he does not understand. But for four months I have traveled through the east talking with folks who represent the public and I believe I know what they are thinking about radio.

A year ago everybody was anxious to hear something via radio. Any old thing would do. The novelty of the experience was what appealed to them rather than the information or entertainment that was conveyed. Brought to a pitch of excitement by hectic publicity they began buying radio sets. The demand swamped the manufacturers and the dealers. The situation appealed to that class of sharpers who are entirely satisfied when they have separated a fool from his money. When the reaction against dishonesty comes in their line of business they are already out of it and busy on some other side scheme. Unfortunately there is no open season on animals of this kind. Killing them is murder just the same as though you croaked a regular human being.

Today I find wherever I go four classes of persons among the radio public. Here and there is a man who, starting as a novice with a tube set, has learned to operate it and get results. In August I discovered the first man I ever met who, with a detector, two step amplifier and loud talker was regularly entertaining his family and friends with music that satisfied and lectures and sermons that could be understood. I met many who said they were doing this but, with due respect to the veracity of radio enthusiasts, I am compelled to say that some of them stretch the truth as a matter of habit. They claim to enjoy radio music themselves and then deny the assertion by bringing in a snatch of a song or a bar of an instrumental selection and then quickly tuning it out to see if they can get something from another station. Time after time, when such radio bugs have been demonstrating to me how much their families enjoyed radio, the said families have quietly disappeared from the radio room, to be found later deep in the discussion of millinery in some quiet nook.

This fellow in Pennsylvania was using a set that I had seen fizzle several times in other locations. His antenna was no better than the average. He had a ground on a pipe that ran from his cottage out into a lake a hundred feet. Maybe that was why he got the results he did. Anyhow, everybody in the village whom I approached on the subject of radio told me to go up to Gleason's if I wanted to hear the real thing. I went, and the results while not perfect were impressive, especially for the season when atmospherics are most likely to be troublesome. Such a man will keep a whole community sold on radio. He should be sought out; stories should be written about him for the local papers and national magazines. He is a big asset in the business.

The second class of persons I met are those who have tried radio and are through with it. Some of them bought crystal sets although they were many miles from the nearest broadcaster. Some bought tube sets and, before they mastered them, were disgusted by mistakes that cost them the price of new tubes, by interference that they could not get rid of, or by unsatisfactory reception. They are hard to deal with.

The third class are those who got excited about radio but did not buy. They are congratulating themselves on their acumen. They are not prospects and will not be until approached on a new basis or by means of better demonstrations than dealers usually give. Here is a letter from one such man:

"Personally, I have my doubts about the area of interest to be occupied by radio in the future. At present it is having a scattered existence, and to the most intelligent mind its utility is very small indeed, in-so-far as their personal amusement, entertainment or education are concerned.

"My personal experience is that it is a very good noisemaker, but as yet it has nothing of the artistic connected with it. The information it gives can be gotten so easily from other sources that I have been forced to abandon my early enthusiasm about its usefulness in the home. The whole art may be in its infancy, and perhaps we are now in the "working out" stage.

"I would not do anything to discourage or disqualify, but up to the present time I cannot find any value for this apparatus in the home, excepting in scattered or farm communities where the ordinary means of communicating information are slow or absent."

AFTER traveling throughout the East and studying present conditions Mr. Perry wrote this article, in which are explained a good many reasons why the Radio business is not this season as prosperous as last year. We suggest to the manufacturers and dealers that they read this article, and take note of details pointed out by Mr. Perry, as being important to make a success of a sale to an interested but inexperienced prospective customer.—Editor.

The writer of this letter is not an ultra-conservative or an old fogy. He is an up-to-date banker. He was strongly interested in radio a year ago. Several times he was on the point of purchasing a set for his home. He was able and willing to buy one as good as could be obtained. Demonstrations by radio dealers killed the sale. Unfortunately, this gentleman is the head of an organization with over half a million members and an influential member of others. A favorable attitude on his part toward radio would have counted heavily in the radio business.

The fourth class of persons is ten times as large as all the others. It consists of those who have heard about radio but who have not had enough experience with it to form a definite opinion. They want it if it will do what some say it will and if they can afford to have it. They are the slow-acting but substantial folks upon whom any permanent business must ultimately depend.

How can we keep all these classes sold on radio? In trying to find an answer to this question I have done a deal of listening-in by radio and otherwise. The air is full of interesting things. I pick up a lot of news that I know is of interest to bankers because I tell it to bankers and they are interested. Many items are of interest to merchants. The time signal can always be depended on to interest anyone who is around when it arrives. The local radio concerts form a pleasant background for my work as I punch the mill and they entertain my callers. The lectures save much reading and it is more interesting to hear the man who knows the subject than it is to read what he writes. If any part of the public that is normally interested in music, lectures and news is not interested in receiving the same things by radio it is because there is something the matter with radio, as managed at present.

On the broadcasting side there has been marvelous development in a year, both in quality and quantity. In many cities or anywhere within range of their broadcasting stations it is possible to pick up something worth while at almost any time of day and far into the night. Yet I doubt if one per cent of the potential radio public hears anything. Look for antennae as you ride through the country and, though there is always one in sight there are ninety-nine houses without them to one that is equipped, except in the larger cities. Talk with those who have no receiving apparatus and you hear things like this:

"I will have to wait till it gets cheaper, I haven't got a hundred dollars to spend for it." "I am going to wait until they get the apparatus perfected. Bill invited me over to his house three times to hear a concert and he couldn't get a thing either time. Said he got it all right every other night, but he will have to show me."

In December, one of the best radio months, a Boy Scout whom I had never seen before leaned over a seat in the balcony of the national House of Representatives to tell me that he had been unable to get anything with the radio-frequency set that his father had bought for him. Another Scout beside him asked me for advice about a vacuum tube that could not be induced to function with his loose coupler.

One of two things is going to happen: either there is going to be a sudden and marked improvement in sales methods or large sections of the general public are going to get the idea firmly fixed in their minds that radio is something to be heard once or twice and then left alone until it is developed into a cheap and practical household utility. Once that idea is firmly fixed, the condition will be worse than it would have been if the knowledge of radio had been kept from the public altogether.

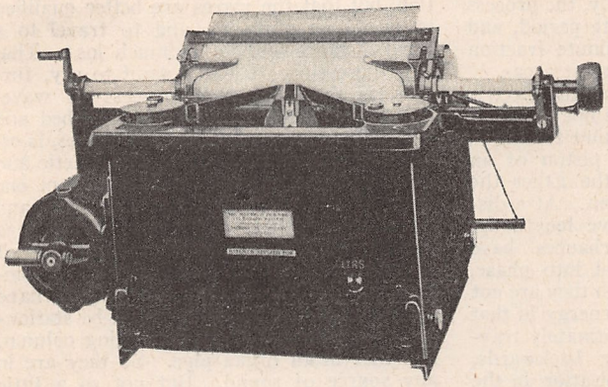
The manufacturers were wise when they offered simplified apparatus. The big mistake from my point of view was in basing the selling arguments on the fact that it would bring in music and voices from very distant stations. The general public is satisfied for a while by hearing the nearest stations. Recently a small town paper stated with pride that a local boy had brought in voices from a distance of more than three miles! But the publicity made many radio purchasers dissatisfied with any program that did not come three hundred miles at least. Instead of interesting people in the local broadcasting stations it engendered hatred of them. The technical amateur's slogan: "long distance or nothing," seemed to gum the whole game. What seems to be needed is to make a reasonable objective popular and to give demonstrations to all purchasers, showing them just how they can attain it.

The technical amateur's ambition to develop radio communication over long dis-

(*Continued on page* 1586)

Secrecy In Radio Communication

By J. O. CARR



Left: The Teletype Receiver Which Automatically Prints the Incoming Messages. Right: A View of the Actuating Mechanism and Keyboard of the Teletype Transmitter.

RADIO communication is at a disadvantage compared with land line or cable communication. Anyone with a simple receiving set tuned to the proper wave-length can listen in on the most important radio message. While it is against the law to divulge the contents of any message picked up in this manner, still it is not against the law to think, and who can say that the person obtaining knowledge of some important communication will not be influenced by that knowledge if it affects his interests?

This applies particularly to press matter. Press matter is the most perishable commodity there is. A big story is worth thousands of dollars now, and in an hour it is valueless, for it has been published and has become public property. Millions of dollars per year are expended by the various newspapers and press associations to gather news, and unless the agency that gathers the news can maintain its secrecy until delivered to its clients, much of this expenditure is wasted.

Of course, the matter to be transmitted can be enciphered and then deciphered at the receiving station, but this means a considerable loss of time and the time element is vital in the transmission of news.

The better way to render radio communication secret is to use automatic transmitting appartus which utilizes a code that cannot be read by ear and at the receiving station automatic receiving appartus which will translate these code impulses into typewritten characters.

We have recently read in the newspapers and radio publications of the work which the Navy Department has done in securing typewritten communication between a moving airplane and the earth. It was stated that successful operation was secured and the typewritten characters were clearly printed at the base station, while the plane was traveling at a high rate of speed many miles away.

The instrument used in the tests of the Navy Department was the Teletype, which is a greatly simplified form of printing or automatic telegraph. It is obvious that space and weight limitations for apparatus to be used in airplanes are rigid, so that it was necessary to reduce the size and weight of the apparatus to the greatest possible extent. This was done without interfering with the functioning of the apparatus to the slightest degree.

The signaling code employed by the Teletype bears no resemblance to the Morse code. It is known as the five-unit code, since each letter is of the same length, the time length of a letter signal being divided into five intervals. The different letter combinations are produced by sending a radio signal or impulse for one or more of the intervals and leaving the others blank. For instance, in the case of letter "A," a radio signal is transmitted during the first two intervals and the last three are left blank. In the case of the letter "R," no signal is transmitted during the first, third or fifth intervals though a signal is transmitted during the second and fourth. The blank intervals serve merely to space or locate the signaling intervals. It should be borne in mind that when signals are transmitted for two or more successive intervals there is no break between the intervals. For this reason it is impossible to read the signals by ear as the sounds heard in the receiver are of such varying durations and so unequally spaced. In addition to this feature, the signals of successive letters are joined together.

As Shown Above, Each Letter or Sign Has the Same Time Duration and is Distinguished by Means of a Combination

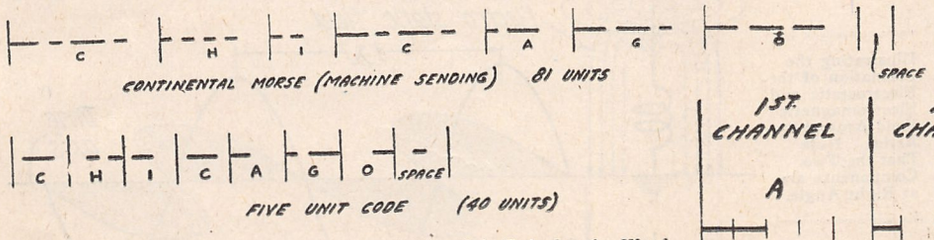
It can be seen by referring to the code diagram just how difficult it would be to read the letter signals by sound. For instance, for the letter "A" the sound would persist for two intervals, the first and the second, while for the letter "U" the sound would persist for the first, second and third intervals, and for the letter "K" there would be a sound during the first, second, third and fourth intervals. It can be readily understood how difficult it would be to distinguish between these dashes which differ only slightly in length.

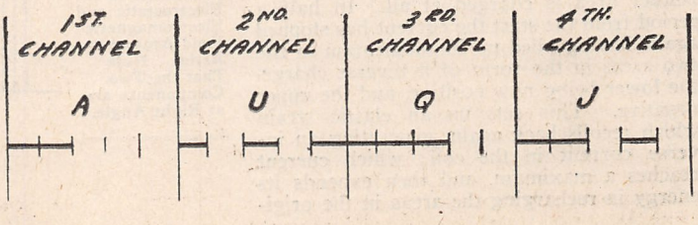
Then again, it can be seen that the duration of the sound for the letter "I" is the same as for the "A," but its relative position in the letter interval is different. Thus, in order to translate the code signals by sound, it is not only necessary to accurately judge the duration of the various sounds, but also to accurately judge the time interval between them.

While it is true that for a single transmission system using five-unit code, a start interval and a rest interval are added which may assist in deciphering the code when it is printed in dots and dashes of varying lengths on a paper tape, when multiple transmission is employed no such aid exists and the problem is rendered much more difficult.

In multiple Teletype operation, the radio transmitting appartus is controlled by two or more automatic transmitters. Assuming that there are four automatic transmitters, number one will transmit a letter, then number two, followed by numbers three and-four and then number one again, etc. These transmissions take place in close succession so that in case the last interval of number

(*Continued on page* 1540)





Above: Time Comparison of Continental and Five-Unit Code for the Word "Chicago." Right: Four Channel Multiple Transmission System.

On the Transmission of Waves

By SIR OLIVER LODGE

THERE seems to be a good deal of misunderstanding as to how electric waves are propagated from an aerial, not only as regards the distance traveled, and the way in which they get round the curvatures of the earth, but as to their actual mode of propagation, and the process which is going on in the Ether, so that they are able to advance with the velocity of light. For electric waves are not only electric, they are electromagnetic: that is to say, they have an electric component which is detected at a receiving station by an elongated or linear conductor; and they have a magnetic component which is detected by a closed loop or coil of wire. These are the two kinds of aerials in common use, the elevated wire and the closed loop. One responds to the electric, the other to the magnetic oscillation; and it is pretty well known that these two oscillations are at right angles to each other, and that it is most efficient to have the electric one vertical and the magnetic one horizontal. It may also be known that they have equal energies, and necessarily have equal amplitude, so that the weakening of one equally weakens the other. The whole progress of the wave depends on the co-existence of these two forms of energy, the electric and the magnetic; and if one stops, they both stop. If one is reversed, the other must be reversed if the propagation is to continue in the same direction. If one is reversed without the other, the wave goes backwards. And if at any place the one exists alone the wave stops, and at that place you have either an electric phenomenon or a magnetic phenomenon, but not both.

The consequence of all this is that the electric and magnetic disturbance must be coincident in position; one cannot lag behind the other in a true wave. Whenever one is at a maximum, the other must be at a maximum; which is expressed by saying that they must be in the same phase, as a condition of the progress of the wave.

Yet it is often taught that one is a quarter period behind the other, like the piston and slide valve of an engine; so that when one is at the extremity of its swing, the other is in mid course; and that the energy oscillates from one form to the other, being alternately kinetic and static. For magnetism is due to current or kinetic energy, while electrification is due to static or potential energy; and in ordinary cases they do not co-exist. You may have an electric current, or you may have a charged body. Wherever you have both, you have oscillations and the generation of waves.

But the curious thing is that at the generator the energy really does oscillate from the static to the kinetic form, and back again. Consider an ordinary aerial, with a capacity area above and below, and a coil in the middle between them. At one instant the upper area is charged positively, the lower area negatively, and there is no current in the coil. At the next instant, separated from the first by a quarter period, the current in the coil is a maximum, and neither area is charged at all. In half a period from the start the current has stopped again, having piled up its momentum in the two areas in the form of a reverse charge, the lower being now positive, and the upper negative. This sets up an elastic strain which recoils back again, generating an inverse current in the coil; which current reaches a maximum, and then expends its energy in recharging the areas in the original way. And so on periodically, the process just recorded being a complete period, and occupying of course a very minute fraction of a second, even with the biggest areas.

Hence at the emitting station the electric and magnetic disturbances are not in phase. One lags a quarter period behind the other, just like the slide valve and piston of an engine. A little way off in the Ether the conditions have become different. At a distance of about a quarter wave length the electric and magnetic disturbances have caught each other up, and got into phase. Within that quarter wave-length they are not in phase; and accordingly the energy in that space oscillates to and fro, alternately traveling outwards and traveling backwards, from and to the source,—a pulsation in the Ether,—and no true wave is broken off or emitted within the first quarter wave length. But at a certain distance, which was calculated by the great discoverer, Heinrich Hertz, in the light of Clerk Maxwell's theory, some of the energy is flicked off at every oscillation. At that distance the two etherial disturbances have got into phase. They are coincident with each other, and when that happens the only way in which they can co-exist is to fly along with the velocity of light; which accordingly they continue to do, until their energy is somehow absorbed or dissipated by conductors. Hertz gave diagrams of the whole process, according to Maxwell's principles, before the year 1890, and thoroughly understood it.

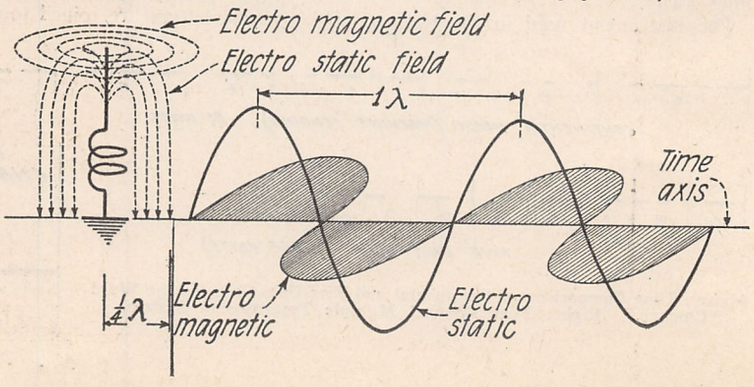
That is why an ordinary alternating dynamo of commercial frequency emits no appreciable waves. The place whence waves would start is a quarter wave length away. And if the oscillations are a hundred a second, the wave length is 3000 kilometers, or say 2000 miles, so that the quarter wave length is 500 miles. And the waves from an alternator of 100 a second in New York would not begin till about the distance of Pittsburgh; that is to say, practically they would not begin at all, though theoretically it is true that every alternator must emit waves of infinitesimal strength. But the waves only become strong and important when the frequency of oscillation is very great; and the higher the frequency, that is to say, the shorter the wave length, the greater is the proportion of energy emitted in radiation. The advantage of long wave length is not that more energy is emitted, for a given horsepower of the sending station, but that the waves are better qualified to overcome obstacles, and to travel to a great distance without so much loss. That is a digression. What I want to say, further, is that the above process of wave-transmission, which has been described and worked out for electromagnetic waves, is essentially true of all waves. The kinetic and static energies are not oscillating from one form to the other, but are coincident and traveling together. Professor Howe has recently pointed out that it is true even of sound waves. At the place of greatest compression or rarefaction we might have thought that the particles would be stationary. So they are in an oscillating column, like that in an organ pipe. So they are in any source of sound. But not so a little distance away: not so in a sound wave, as distinct from the alternating pulse which generates a sound-wave. When we study the phenomenon in a true wave we find that the particles in a condensation, or greatest compression, have likewise their greatest speed. They are traveling full-speed forward, while in a rarefaction they are traveling full-speed backward. The static and the kinetic energies agree in position, just like the electric and magnetic. It is at the intermediate parts of the wave that we find them both momentarily zero. The particles are stationary at the places where the air is of average density, not in a compression or rarefaction. Hence the theory is very general, and those models which have been constructed to illustrate the propagation of waves, and to show the lag of one form of energy on the other, are erroneous. They only apply to the oscillator, not to the waves. So-called stationary waves, the result of reflexion, are essentially akin to an oscillator. True waves must advance. The fact that the true wave only starts a quarter wave length away from the oscillator is very instructive. It applies even in the case of light, although in that case the oscillator is of ultramicroscopic dimensions; and the frequency hundreds of millions of millions per second; so that the following-out of the process in detail might seem impossible. But it was not impossible to the great mathematician, Sir George Stokes, who in his work on Fluorescence arrived at the conclusion that the quarter wave lag or difference of phase at the start must be compensated or neutralized so that it became obliterated in the true wave.

It is in many respects the same even with waves on the surface of water. The particles of water are moving forward on the crests, and are moving backward in the hollows. They are moving only up and down at the position of mean level. If you watch sea waves traveling along in deep water, you will not at first notice the motion for-

(Continued on page 1536)

WE are pleased to present to our readers, this most interesting article on the transmission of waves written by one of the foremost English authorities on radio.

Sir Oliver Lodge, well-known in scientific circles, is one of the pioneers of radio and has set forth some of its principles. In the present article, he explains in a clear and concise manner, how the electro-magnetic waves are propogated through the ether, a thing which is not generally well understood by the amateur.—Editor.



Illustrating the Formation of the Electrostatic and Electromagnetic Field Around an Aerial. Note That the Two Components are at Right Angle.

Electrons, Electric Waves and Wireless Telephony

By DR. J. A. FLEMING, F. R. S.

Part 1

NOW that the wonderful art of wireless telephony has reached a point in its development at which it is rapidly becoming a popular pastime in place of an exceptional feat by experts, there is naturally a demand for expositions of the scientific principles underlying it, which shall be capable of being understood by the general reader.

This is not adequately supplied either by the highly technical journals or by the bulk of the popular wireless literature being poured out from the Press. Mere pictures or even semi-technical explanations of the mysteries of receiving circuits or the mode of employing thermionic valves or crystals for "listening in," do not entirely meet the public requirements.

This remarkable achievement of applied science is the outcome of the great advances which have taken place in the last quarter of a century in our knowledge concerning atoms, electrons, electric waves and electrical physics generally.

An intelligent comprehension of the *modus operandi* of the technical appliances used in wireless telephony necessitates, then, some slight acquaintance with modern scientific views concerning the nature of matter and electricity, and the possible relations of these to the more fundamental conceptions of ether, space, time and energy.

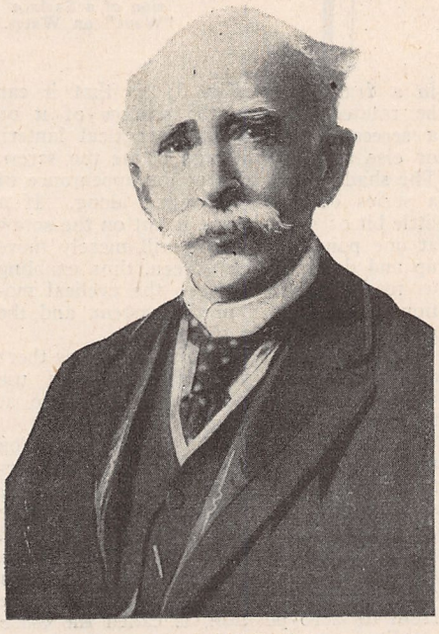
Probably the chief gain which will result from a keen popular interest in wireless telephony will be an increased public attention to the progress of electrical science. In view of recent important advances in pure science, most of our textbooks on electricity as used in "Schools and Colleges" require to be rewritten.

It is now seen that we have to put on the scrap-heap much of the electrical theory and many explanations of physical phenomena formerly deemed satisfactory, and start with fresh ideas.

In the following articles an attempt will be made to give in outline an account of some of these modern ideas, and advances in recent physics, as far as they bear on the evolution of wireless telephony. The highly technical details of wireless apparatus and its expert management will not so much concern us, and, in any case, is provided for in other publications and books.

When anyone not in the least acquainted with the facts of electrical physics, asks a wireless operator to explain the nature of his operations and appliances he is generally informed it is accomplished by the use of "electric waves." But any attempt to progress beyond the stage of mere phrases generally places the expert and the inquirer in difficulties.

To answer this question at all efficiently renders it necessary to build up from a deeper foundation and consider in detail what is meant in scientific language by the term *wave*. It is essential therefore to start from a consideration of familiar physical effects which can be seen with the bodily eyes, and to make of these stepping-stones by which we may be enabled to understand something of analogous processes which can only be appreciated with the eyes of the mind.



DR. J. A. FLEMING

THE series of articles by Dr. J. A. Fleming, F. R. S., which which will appear under the above title, is a reproduction, with some additions, of the Christmas Lectures on Electric Waves and Wireless Telephony he gave at the Royal Institution, London, in December and January, 1921-1922. Radio News has been able to secure the exclusive serial rights of publication in the U. S. The articles are therefore copyrighted, and rights of translation and reproduction are strictly reserved.

It is hardly necessary to remind the readers of Radio News that Dr. Fleming has been closely and practically connected with the development of wireless telegraphy and telephony from the very beginning, and was last year awarded, by The Royal Society of Arts, the Gold Albert Medal.

1. SURFACE WAVES ON LIQUIDS

The easiest avenue of approach to the study of waves in general is to discuss some of the properties and the nature of the visible surface waves in liquids. We are all acquainted with the appearance of the sea surface when it is traversed by and tossed up into waves, and also with the effects produced on the surface of still water when it has ripples created upon it by the splash of a stone thrown in. In common language we apply the term "wave" to the splashing water thrown up on the beach or rocks at the seaside (Fig. 1). This, however, is merely the result of the break-up or end of a wave, and in a scientific sense of the word it is not more properly called a wave than a house in the act of falling down could be described as a "desirable residence."

To understand what is meant by a surface wave in scientific terminology we must go out a little distance from the coast over deep sea water on some breezy day. We shall then see what appear to be rounded elevations or hummocks on the water, which move forward. To the inexperienced eye it seems as if the surface water, as a whole, was in motion in one direction.

If, however, we fasten attention upon some floating object, such as a patch of seaweed or a seagull sitting on the water, we see that as each wave passes under it the floating object is merely lifted up, pushed forward a little, then let down and drawn back, and, in short, never moves far from one position. A little thought makes it evident we have to distinguish between the motion of the water particles *per se*, and the motion or change in position of the elevations and depressions in the water surface.

We can watch with the eye the progress of a certain hump or ridge on the surface, but that hummock does not consist of the same particles of water for two successive instants.

At any one spot the actual extent of the displacement of individual particles of water may be small, and the progressive movement is merely the apparent change

Fig 1.—We Usually Apply the Term "Wave" to the Splashing of Water Thrown up on a Beach. This, However, is Merely the Break-Up or End of a Wave. The True Wave May Only Be Seen Some Distance from Shore.

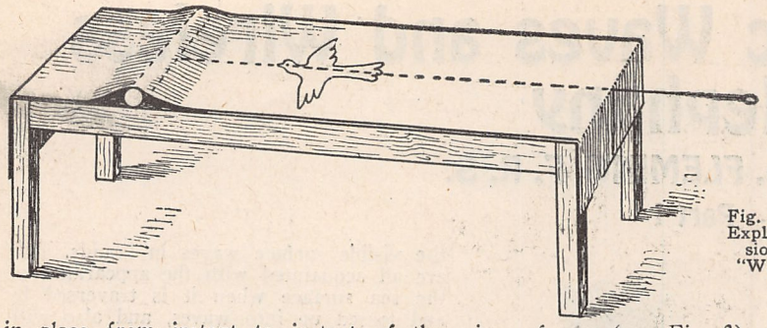


Fig. 2. — A Model to Explain the Progression of a Surface "Wave" on Water.

in place from instant to instant of the locality at which this displacement or motion is a maximum or minimum. A simple illustration of the effect may be obtained by laying transversely upon a long horizontal board a cardboard cylinder about the same length as the width of the board. To this cylinder is attached a string by which it can be pulled along parallel to itself. Over the cylinder is laid a strip of green cloth which must be taken to represent the sea surface. A small piece of paper cut out in the shape of a seagull or a small stuffed bird may then be pinned to

Fig. 3.—A Spiral Wire, the Shadow of Which, When the Wire is Rotated, Imitates a Series of Progressive Waves.

the cloth. If, then, the card roller is pulled along under the cloth each point of the latter will be successively raised and lowered. A moving elevation of the cloth in the form of a ridge or hummock will travel along the cloth and imitate by its action on the model bird the behaviour of the water at one point and at various points in the path of the wave.

2. DEFINITION OF WAVE MOTION

We are then able to give a definition of wave-motion as follows:—

If the particles of any material or parts of any construction perform successively, meaning by that one after the other and not all at once, any kind of movement or displacement in which they start from and come back to a given point, this constitutes a *wave motion*. We can see this process illustrated when a gust of wind blows over a field of ripe corn. Each ear or row of ears along a certain region bows down under the pressure of the wind, and then springs up again. Row upon row of the corn-stalks, successively, make their obeisance in this fashion to Hermes, and the result is that a sort of shadow sweeps over the field, very beautiful to behold, which constitutes a kind of wave.

A wave does not necessarily involve motion. It may consist in any kind of cyclical change repeated from point to point along a certain line. Thus, suppose we have a very long row of incandescent electric lamps, which by some contrivance can be switched on one at a time for a moment, and then off again. If each lamp in turn, one after the other, progressively along the row, is thus illuminated for an instant, we shall see a wave of illumination propagated along the series of lamps.

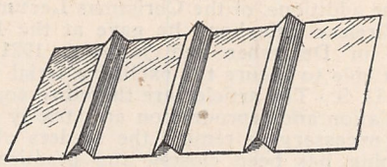
If at each point in the series the motion or change is only performed once, we have a so-called *solitary wave*. If at each point it is repeated at regular intervals we shall have produced a *train of waves*.

We can provide an illustration of a progressive wave train in the following way. Wind a length of stiff wire round a pencil or other circular sectioned rod in open turns, like a corkscrew. Fix this spiral in a frame (see Fig. 3) so that it can be rotated. Throw the shadow of it on a screen by means of an optical lantern or else the sunlight, and rotate the screw. The shadow will present the appearance of a series of waves traveling along. If a little bit of sealing wax is put on the screw at one point its shadow will merely move up and down on the screen, thus enabling us to distinguish between the cyclical motion at each point in the system, and the apparent motion of the wave.

When dealing with trains of waves there are four terms very frequently in use which it will be convenient to define at this stage.

At any one point in the wave region the material or medium executes a certain regularly repeated motion, or else some cycle of operations. The number of times this cycle is repeated per second or per unit of time, is called the *wave frequency*. The greatest extent of this displacement or motion, or other change from its zero position, is called the *wave amplitude*.

The shortest distance measured across from one wave hump or maximum to the next adjacent one is called the *wavelength*. It is important for the general reader to



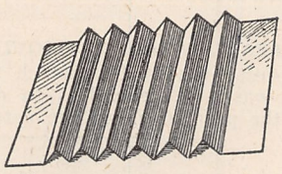


Fig. 4.—Pleated Paper Models to Illustrate the Difference Between Long and Short Surface Waves on Water.

notice that the term "a long wave" does not mean a wave which is long in the direction of the crest, ridge, hump or elevation, but it means that distance between the waves is relatively large. Thus, for instance, if we pleat a sheet of paper so that the folds or ridges are close together, we might take this as an illustration of what is meant by "short" waves. If, however, the ridges or pleats are relatively far apart, they would be called "long" waves (see Fig. 4).

The terms "long" and "short" are, however, relative and what would be a very long wave for certain purposes might be a very short one for others.

Then, in the next place, every wave moves forward parallel to itself with a certain speed called the *wave velocity*. We may, for instance, imagine a bird to fly along over the sea surface in the same direction in which the waves are traveling, and to keep himself always poised above the same crest or hump. The speed with which the bird flies is then the same as the wave velocity.

In all cases of wave motion there is a connection between the wave velocity, the wave frequency and wavelength, as follows:— The wave velocity is numerically equal to the product of the wavelength and wave frequency when using the same units of length and time. Thus, if the water at any place rises and falls ten times a minute, and if the shortest distance from crest to crest or the wavelength is 20 ft., then the wave velocity is $10 \times 20 = 200$ ft. per minute.

Algebraically, the rule is expressed in the formula $W = n\lambda$, where W is the wave velocity, n the frequency, and λ the wavelength.

In many cases the velocity of the wave is quite independent of the wavelength, that is, long and short waves travel at the same speed. This is the case with wireless waves, and those similar waves which constitute light. On the other hand, it is not the case with surface waves on liquids. On the deep sea surface long waves travel faster than short waves.

Approximately speaking, in the case of deep sea waves the wave velocity is about equal to the square root of 2¼ times the wavelength. Thus, waves on the Atlantic Ocean which are spaced apart 300 ft. from crest to crest, or have a wavelength of 100 yards, travel at about 26 miles an hour, or roughly at the speed of a slow railway train. Hence, they catch up a not very quick-moving ship and passing under it, cause the ship to pitch.

3. PRODUCTION OF A WAVE

We must next consider a little more carefully how a wave is produced, and why it travels along when once started.

In order that a true self-propagating wave may be produced on or in a material, the latter must possess two special properties.

First, it must have elasticity of some kind; that is, it must *resist* some kind of change in it, for example, compression, twisting, stretching, or rotation, and must spring back when released.

Secondly, it must *persist* in motion or have mass or inertia, or some quality equivalent to it which causes it to store up energy when moving, or as the displacement is changing. In short, the medium must possess the power of storing up energy in two ways, viz., as potential energy in the form of some strain, or displacement, and as kinetic energy in the form of some motion, or other change not purely mechanical but equivalent to motion or release of strain.

At any one point the energy is being transformed from potential to kinetic form and back again. In a wave motion in which the motion or displacement follows a simple harmonic law the average of the varying potential energy during one complete period is equal to the average of the varying kinetic energy during the same period.

The mode of production of a compressional wave can be studied by means of a simple model made with a number

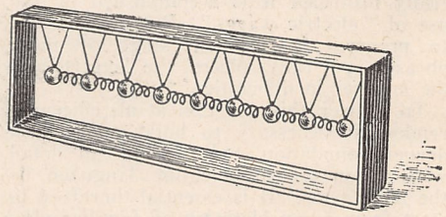


Fig. 5.—A Model Made With Golf Balls and Spiral Springs to Illustrate the Nature of a Longitudinal Wave.

of golf balls suspended from a frame by strings so as to hang in a row, each ball being about two inches apart. The balls are inter-connected by spiral springs of

brass wire, which resist compression or extension (see Fig. 5). If then the end ball is given a sudden blow with a piece of wood in the direction of the row of balls, it is set in motion and its kinetic

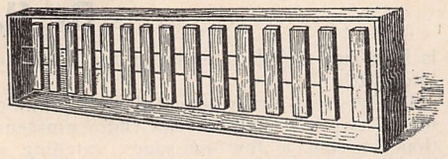


Fig. 6.—A Model Made With Wooden Bars and Steel Wires to Illustrate the Nature of a Distortional Wave.

energy expended in compressing the spring between it and the second ball. Owing to the mass of inertia of the balls the compression is not transmitted instantly to all the springs, but the spring between the balls 1 and 2 after being compressed expands again and brings ball 1 to rest and starts ball 2 in motion. This again compresses the spring between ball 2 and ball 3, and the same process is repeated from ball to ball. The movement and compression is thus handed on and finally reaches the end spring and ball, which latter flies off freely.

It is easy to watch the rather slow propagation of this wave of compression along the row of balls. As an illustration of another kind of wave called a distortional wave, a model of the following description can be made.

Stretch in a long frame a pair of parallel steel wires about half an inch apart. Thread on these wires long slips of wood or metal (see Fig. 6). The steel wires, and therefore the bars threaded on them, resist being twisted relatively to each other. Hence if we give the end bar a transverse pull so as to twist the wires between the bar 1 and bar 2, that twist will then tend to bring bar 1 back to its original place; but, having mass, it overshoots the mark and then the reverse twist applied pulls back bar 2. Each bar then continues to vibrate, but the vibrations of each bar are a little out of step with those of its neighbors on either side. The vibratory motion is passed on from bar to bar with a certain delay in phase, as it is called, and hence we have a wave of distortion transmitted along the collection of bars strung on the steel wires.

There can be as many different types of wave as there are kinds of elastic resistance, and in a solid elastic substance it is possible to have two types of wave produced, one called a compressional wave in virtue of the fact that the solid resists compression and the other called distortional, in consequence of the fact that a solid resists change of shape. We have these two kinds of waves produced in the earth's crust during earthquakes.

4. WAVES ON WATER

In the light of these explanations we can then consider the familiar facts connected with the production of waves when a stone, for instance, is thrown upon still water in a lake.

We know that a free water surface is a level surface and that the water resists being made unlevel, and if it is momentarily heaped up or depressed at any place the force of gravitation at once restores the level.

When a stone is thrown on water and plunges downward through the surface, it creates a temporary depression or cavity in the water. Since water is nearly incompressible, it follows that if the surface is depressed at one place it must be heaped up in some adjacent place. Therefore the plunging stone not only creates a cavity, it also heaps up the water in a circular ridge or hummock all round the depression (see Fig. 7). But this state of the water cannot continue if left to itself. The water rushes in to fill up the central cavity and its inertia carries it up into a column or hump. This involves the production of a ring-shaped depression or trough around the elevation and the first-formed annular ridge or elevation is pushed farther out. The water at the splash point thus bounces up and down, say half a dozen times before it comes to rest, and this creates as many concentric ring-shaped ridges and troughs on the surrounding surface, which then expand outwards as a family of wavelets or ripples (see Fig. 8).

There is one curious fact connected with this ripple band which few persons out of the thousands who throw stones into water have ever noticed. On looking carefully at the ever-expanding band of ripples it will be noticed that on the inner edge little wavelets are continually being produced and others die away at the outer edge. In other words, the waves travel through the band of wavelets faster than the group of waves moves as a whole. This establishes an important distinction between the velocity of *a* wave and the velocity of a *group* of waves.

In the case of wireless waves there is

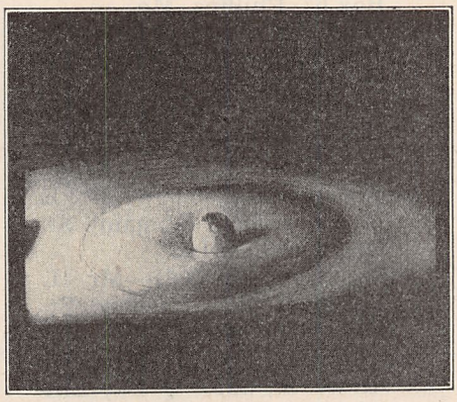


Fig. 7.—An Instantaneous Photograph of a Ball Dropping Into Water and Creating a Circular Wave of Elevation on it.

no difference between the wave velocity and the group velocity, but for sea waves or the surface of deep water the group velocity is half the velocity of the single wave.

The waves on a water surface produced by throwing in a stone or other object, or by the wind, as in the case of sea waves, are called *gravitation waves* because the elastic resistance called into play is that due to the effort of the water surface to remain level under the action of gravitation.

5. CAPILLARY SURFACE WAVES

We can, however, produce another type of wave on a water surface called *a capillary wave*, which depends upon the resistance of the water surface to stretching.

The surface of every liquid is in a state in which the surface particles draw each other together or cling more closely than those in the interior. Hence a certain effort or force is necessary to break through the surface film to stretch it, and this surface layer endeavors always to contract or shrink up to the smallest area consistent with the boundary conditions. This is called the *surface tension* of the liquid or the *capillarity*. This last term is derived from the Latin word for a hair, because the ascent of liquids in very fine tubes such as the sap in a tree up the fine tubular tissues is due to this same action. The ascent of a liquid up a fine tube is dependent upon the condition that the liquid must wet the walls of the tube.

The existence of this surface film upon liquids and its resistance to stretching gives the explanation of the fact that small bodies made of material intrinsically heavier than water can yet float upon it. If a little very clean water is put into a clean saucer, a fine clean steel sewing needle can be dropped upon the surface if held in a horizontal position close over it and released, and it will then be seen to float on the water. The needle is not heavy enough to break through the surface film but makes a little depression in it, in which the needle lies like a baby in its cradle. It is for this reason that small dust particles can lie on water and little insects can run over the surface without risking death by drowning.

We can produce capillary waves on water by holding vertically and half immersed in it a straight stiff fine wire and pushing the wire quickly forward across the surface. Round the point of immersion of the wire will be seen a group of very small waves or ripples which become of shorter wavelength in proportion as the wire is more quickly moved forward.

Again, when drops of water such as raindrops fall on the surface of pools of water, each drop as it strikes the surface creates a rapidly expanding ring-shaped ripple, which is a capillary wave. These are instances of waves on water which depend not upon gravitation but upon a capillarity for their formation.

The fact that a liquid film is in a state of tension and tries to contract as much as possible is easily proved by experiments with soap bubbles. If a soap bubble is blown on the end of a glass tube and the mouth then removed from the blowing end, the bubble begins at once to shrink up, exactly as thin indiarubber balloon would do if inflated with air and then left to itself. Another similar experimental proof is as follows:—Make a wire ring about 2 ins. in diameter, having a long wire handle, and tie across the ring a fine thread, which is not drawn quite tight. Fill the ring with a soap film by immersing it in a soap solution in such fashion that the loose thread is entirely saturated by and included in the film. Then break through the film on one side of the thread,

(*Continued from page* 1549)

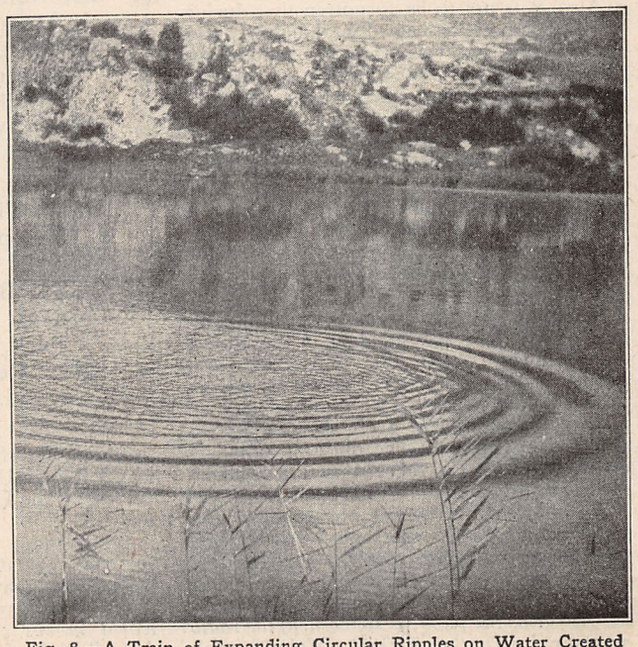


Fig. 8.—A Train of Expanding Circular Ripples on Water Created by Throwing a Stone Into a Pond.

Results of the $500.00 Prize Contest

Radio News'

By H.

IN our October issue we published a special $500.00 prize contest, entitled: "Who Will Save the Radio Amateur?" This was in connection with Mr. Armstrong Perry's article, "Is The Radio Amateur Doomed?"

All thinking men, and most intelligent amateurs themselves had long come to the conclusion, ever since the broadcasting popularity started, that the radio amateur was indeed doomed. By "doomed" is meant not that the radiophone popularity was to wipe out the amateur, but, rather, that IT WAS THE AMATEUR WHO DOOMED HIMSELF, and who put himself out of business. The reason is so simple and so obvious that it is difficult to understand why the rank and file of the amateurs have not seen it for themselves long ago.

OF WHAT REAL USE IS THE AMATEUR OF TODAY? What does he really do to make the world a better place to live in? Of what use is he to the community at large? If the amateur will ask himself these questions, and search his heart, he will come to the conclusion that, indeed, his utility is microscopic. It is true that amateurs are sending each other messages, which roughly covers 90 per cent of their utility. A purely selfish pastime! It is true that some amateurs are sending free messages for their friends, to be transmitted and relayed to distant friends, but investigation of the subject shows that this traffic is indeed exceedingly small. It is a fact that out of 100 messages actually filed with amateurs, not 50 per cent reached their destination! The number of such messages actually delivered is exceedingly small. It certainly has never assumed any proportion where the commercial telegraph interests have even felt it necessary to take any notice of such free-message work.

It is true that amateurs have made creditable records in sending messages, not only across the continent and further, but have sent messages and are sending them right along, across the oceans. This, certainly, is a very creditable scientific undertaking.

Then, too, amateurs, in isolated cases, have helped the police in running down criminals. Such cases, however, do not happen once in six months.

Also, it is not to be forgotten that during the war amateurs helped in building up a radio force that was of great help in the war. Indeed, the writer himself was instrumental in recruiting the amateurs, and secured over 1,000 enlistments, for which he received a very flattering letter from Ex-Secretary of the Navy, the Hon. Mr. Daniels. No doubt the amateurs would do the same thing again, if called upon, but, as one correspondent in this contest put it *"The amateurs can not rest upon past laurels, particularly when there is not a new war every day."*

Summing up, therefore, the real usefulness of the American amateur in the United States is practically nil. This does not sound very nice, but it is the whole, unvarnished truth. The writer, who has been an amateur, and still is, feels that he knows whereof he speaks. The question simmers down to this: "Is there a real usefulness for the radio amateur?" THERE IS NOT! That is, if the amateur is honest with himself. Sending a few messages to each other, making transatlantic records, and waiting for the next war, to show what we can do, does not enhance our standing with the public. *As far as the public is concerned, the radio amateur does not even exist.* Make the following test, which we made recently in New York, and which some correspondents made in various communities in the United States, and you will get a good idea of what the populace thinks or imagines the radio amateur of today to be.

Stand on any street corner, and ask 100 people who pass by the following question: *"What is a radio amateur?"* The answers, boiled down, in about 90 per cent of the cases actually tested, will be as follows: *"Oh! A radio amateur is an experimenter who tinkers with radio apparatus."*

This is then what some 95,000,000 or more people in the United States think of us. In other words, we have never sold ourselves to the public—for a very good reason: WE HAD NOTHING TO SELL, for our usefulness in the United States, up to this time, was nil.

When radio was young, it was all right for radio amateurs to do just what they were doing, that is, sending each other messages, doing research work, etc., *but the world moves on*—WHILE THE RADIO AMATEUR STANDS STILL. As the writer mentioned before, the radio amateur is in a rut, and deep down in his heart he knows it.

If the great and wonderful art of Radio means nothing more to the radio amateur than sending a few messages, catching a burglar MAYBE, sending a few dots and dashes across the ocean, and waiting for the next war to come along to prove, MAYBE, that he can help—then it certainly would have been far better that Radio had never been invented.

We thought that there must be somewhere, somehow, some way to put the radio amateur on the map so that when the name "radio amateur" was mentioned anywhere, in any crowd, or to any layman, there would be instant attention—not a questioning raise of the shoulders, as is the case now. This brings us to our Contest:

As we had foreseen, and as we mentioned in our columns of the October issue, the two articles, "IS THE RADIO AMATEUR DOOMED?" and "WHO WILL SAVE THE RADIO AMATEUR?" brought a number of letters from the narrow-minded and misguided amateurs, who, in their simplicity, thought that we were "knocking" the game, and trying to put the radio amateur out of business. We were assailed from all sides, with many "brickbats," and even the mouthpiece of the American Radio Relay League, who certainly should know better, said things about this contest that not even a third-rate, slandering, country newspaper would stoop to utter. That, however was expected. We were even questioned about the $500.00 Prize Contest, and it was darkly hinted that we were chasing the dollar in making this offer, but just how we were to do this was not mentioned. We offered the $500.00 in prizes in good faith, and are paying out these same $500.00 today in the same good faith, cheerfully, because we know that we have accomplished something that will help to make radio amateurism in this country a real force.

The contest, from every point of view, with one exception, was the biggest we ever staged. Over 5,000 replies were received from amateurs all over the world, and we received many wonderful and inspiring letters. A thing that pleased us particularly was that letters from the best amateurs in this country were in the majority, and many hundreds were received from members of the American Radio Relay League, the Radio League of America, and all of the prominent radio clubs in the country. The one fly in the ointment was that nearly one half of the contributors did not take the time to read the conditions, and indeed did not get the spirit of the Contest. On page 795 of our October issue, is the gist of the entire contest, in these words: *"What we wish, therefore, fellow amateurs, is a manuscript of not more than 1,000 words, setting forth your idea as to the best plan to put the radio amateurs on a solid footing, where they can perform the greatest good for the community, and for the radio art."* That was our message. Nearly one half of those who answered, evidently, did not take the trouble to read this, or, if they did, they thought the contest referred to something else. The fact remains that 50 per cent of the contributors tried to save the amateur by trying to devise new legislation, to protect him! What these contributors did not see at all was that *no force in the whole world can save the amateur except the amateur himself.* Most of these correspondents had an idea that the amateur was doomed on account of the interference which he is mak-

PRIZE WINNERS

First Prize ($200.00)—Mr. L. W. Grundy (1 BZL), P. O. Box 67, Phillips, Me.

Second Prize ($100.00)—Mr. Jesse Marsten, 909 Beck St., N. Y. C.

Third Prize ($75.00) — Mr. Hugh Wingett, 1205 Stainback Ave., Nashville, Tenn.

Fourth Prize ($50.00)—Mr. E. T. Jones, 3997 Dumaine St., New Orleans, La.

Fifth Prize ($25.00)—Mr. L. VanSlyck, 123 Hibbard St., Ironwood, Mich.

Sixth Prize ($25.00)—Mr. Stem Anderson, 3257 Q St., Lincoln, Neb.

Seventh Prize ($25.00) — Mr. Frank H. Fanning, 301 Holt St., Ashland, Ky.

Honorable Mention:

Mr. Ernest G. Underwood, Elwood, Calif.

Mr. Allen H. Duncan, 32 Waverly Pl., New York City.

Mr. Sumter B. Young, (1 AE) Associate Member I. R. E., formerly Chairman Boston Executive Radio Council, Dorchester 24, Mass.

Mr. A. W. Parks, Easton, Pa.

Mr. J. F. Tolley, New Orleans, La.

Mr. Thomas C. Howard, Newport, R. I. (1 A F N).

Mr. L. R. Felden, 979 55th St., Brooklyn, N. Y.

Mr. H. F. Rook, Ridgefield Park, N. J.

Mr. Rex Durant, Cricklewood, London, England.

"Who Will Save the Radio Amateur"

Greatest Prize Contest

GERNSBACK

ing. Nothing can be more erroneous. We never had such an idea in mind, and nowhere did we print a single line about such a thing, or even suggest it.

The truth is that the amount of interference that the public is getting from the amateur is insignificant. There is very much more interference from the commercial stations than from the amateurs, and we believe the public at large knows and appreciates this. Moreover, amateurs are learning not to send during broadcasting hours, and within the next six months *this problem will be solved entirely by the amateurs themselves,* so there is little need of legislation on that score. Even a single circuit crystal set, unless it is right under the shadow of an amateur's transmitting aerial, does not, as a rule, experience much interference from 200 meters. The wave-length of most amateurs does not go much above 250 meters, and this, we might say, is exceptional, so why worry on that score?

To resume, our contest has been a great success. The suggestions that are made in the seven prize-winning letters are very substantial, and, if followed, will surely put the amateur on the map in a very short time, but—like your doctor—we can only give the prescription. It is up to the patient, the radio amateur, to take his medicine, which, in this case, is quite pleasant, and, we are certain, effective.

The judges of the contest were as follows:

H. Gernsback, Editor of Radio News.
L. G. Pacent, President of Pacent Electric Co.
Robert E. Lacault, Associate Editor of Radio News.
Armstrong Perry, Author, and
L. M. Clement.

The judges were almost unanimous in their decision on the seven prize-winning letters, and there was little divergence of opinion. Mr. L. W. Grundy was awarded first prize, mainly on account of his suggestion to re-transmit broadcast programs over the electric light lines. This, indeed, is one of the best suggestions advanced, and we have more to say about this in another section of the magazine. (See article: "Popularizing Radio.") In addition to the prize winners, there were eight letters which were deemed of sufficient importance to be awarded Honorable Mention. These letters will be published in subsequent issues. Some of the prize-winning letters follow:

WHEN we announced our $500.00 Prize Contest, we maintained that the radio amateur was doomed unless he did something to become a power in the community instead of being a question mark. We said that the amateur activities at the present time gained the community nothing. We offered $500.00 in prizes to have the amateurs evolve plans to make a force in the community.

Some of the good points brought out in this contest, and which were awarded prizes, were as follows:

Re-transmitting broadcast programs over the electric light lines, for the benefit of users of cheaper sets, and for those who are out of range of the big broadcasting stations.
Single Control Receiver, to popularize Radio with the public.
Signboards in front of amateurs' houses, giving bulletins of all important news to the community.
Relaying weather, crop, and market reports.
Doing away with spark transmitters—using C.W. only.
Nationwide publicity through local newspapers, for amateur activities, performing real service.
Equipping all transmitting sets with phone, to inform local listeners that amateurs are not interfering with broadcasting.

Is the Radio Amateur Doomed?

By L. W. GRUNDY, 1 BZL

FIRST PRIZE

If he becomes selfish and self-centered he is doomed; but he won't, he will adjust himself to circumstances and be as indispensible as he was yesterday. Time will arrange all things.

Broadcasting is here to stay. The public wants it; they will get it; they ought to have it. If amateur transmission interferes, we must suspend same during reasonable hours. However, the listener to broadcasts must share the air, he cannot expect full control from 10 A.M. until midnight. 8-10 P.M. or 7:30-9:30 is time enough when one considers he has it every evening. The amateur's work is valuable. Most broadcasting is mere amusement. It has its place but it cannot be selfish and "hog the ether."

Let's own up we all like to listen in once in a while. What is to be the amateur's attitude toward broadcasting? We must gracefully accept it and as a public need, help further it. There is chaos in broadcasting now but the inexorable law of evolution, the survival of the fittest will prevail. How can we help? Let's give kindly unbiased advice in regard to selection of sets to cover the required distances. This will prevent the buying of inferior, hence unsatisfactory goods. I butted in once when I heard a misinformed clerk tell a young woman that a crystal set would bring in KDKA six hundred miles away. I simply suggested that a regenerative set would do much better. The clerk sold the better set, it worked, everybody happy and satisfied. Let us show novices how to tune their sets, and get the most from them, for few novices can handle a tube set without guidance. Let us tackle receivers, freedom from QRM means freedom to transmit.

But we want to transmit. When the new White Radio Bill becomes a law let's re-transmit some of the excellent programs over the electric light lines or through the air for the benefit of users of cheaper sets. Here's a field for experimentation and service. Let us open our homes to the public, let's put our loud speakers in halls, homes, churches, schools, etc., and give them a free concert. The public will appreciate the public-minded amateur. Let us post market and weather reports, news items and other things of public interest. One amateur posted the World's Series' results before they came over the wire. A friend of mine invited in a father and mother to listen to a glee club broadcast four hundred miles away and their son was the accompanist. Did they enjoy it? Just imagine! In some of our small towns no Marine Bands nor high class performers ever come. Broadcasting is their blessing.

Let us prepare ourselves for the new era. Let us ban, as quickly as possible, by example and advice, the spark transmitter. Let's push C.W. It's the thing we need. We will experiment with directional transmission and hence avoid interference. Above all we need a wave meter, using it to keep strictly within our wave bands. When we have opportunity for self-policing let us do it efficiently. We should make our relay and DX work of greater value. Let's make the subject matter of the message as important as distance itself. It seems that we may add greatly to the radio art by doing research work.

Another field for service is in the realm of the boy. Radio keeps boys at home instead of in mischief-making gangs. It instills a thirst for scientific knowledge and hence stimulates manhood. A few dollars in radio supplies coupled with a friendly interest will save many a lad from going wrong. Boys often lack cash. Let's teach them the possibilities of materials at hand, —cardboard tubes,—brass screws, a spool of magnet wire. The writer used, one winter, a regenerative set made of ice cream containers, brass screws for switch points, ink bottle stoppers for knobs. The set cost without battery $14.80 and it covers a range of 500-800 miles. As I have been writing, a lad has just brought in for my inspection some tubes made of sheathing paper and shellac. But let us teach painstaking care, efficient layout and mechanical thoroughness even with humble materials. We can teach code classes, we can broadcast interesting materials as code practise. We can show that a single amplifying tube can outrange the average spark coil.

If we amateurs will lead the boys of our communities we will make ourselves indispensable and contribute to community and national welfare.

Ours is an educational task. Amateur leaders must make the rank and file see the light. We must work through the various organizations, we might add a home service branch to our Relay League with distinct and definite duties in regard to community and public service. We must preach and practice service.

The writer is a deep-dyed amateur, he has tried to serve. Four hundred people listened in at his home during November and December, 1921. A new cage aerial lately swung into place has elicited commendation and within 24 hours a neighbor "tickled his palm" with a five spot, "in recognition of your willingness to let folks listen in and because you have helped the boys of this town." Let us be patient to serve rather than arbitrarily selfish and we can make ourselves and our cause, amateur radio, positively vital. I do not worry, the amateur is resourceful enough to adjust himself to any condition and he will; and *Long will he Live.*

A Suggestion for Utilizing the Amateur's Technical Knowledge and Avoiding the Clash With the Lay Radio Public

By JESSE MARSTEN

SECOND PRIZE

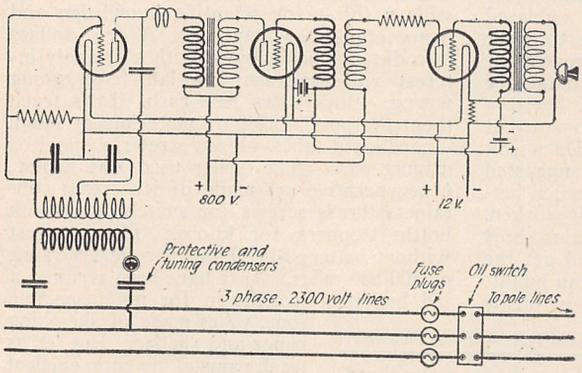
The radio industry will develop and flourish in direct proportion as the number of

(*Continued on page* 1578)

Our Popularizing

IN our December issue we printed an editorial entitled "Popularizing Radio —A Double-Barreled Scheme." Mr. H. Gernsback set forth a new plan whereby it would be possible for communities to enjoy broadcasted entertainments although they themselves were practically out of range.

It was felt, and actual statistics prove this, that outside a 25-mile radius from a broadcasting station only an exceedingly small percentage of the populace can enjoy broadcast entertainment, for the reason that a majority of the people can neither afford expensive vacuum tube sets that bring in the distant station, nor, if they can afford them, do they feel that they are sufficiently versed in radio matters to operate such sets.



Hook-up of a Radiophone Transmitter for Line Radio Transmission.

The idea, therefore, was that the amateurs should relay broadcast programs, so that the small community could receive this relayed broadcast on crystal sets, which the members of the community would either buy themselves or rent from the amateur doing the relayed broadcasting.

We received many letters, some from the greatest radio experts of the country, endorsing the idea. A number of these letters are reproduced herewith. We also reproduce a letter from the Department of Commerce, which is of more than passing interest.

When the editorial was written we, of course, were aware of the fact that at the present time the rules of the Department of Commerce were such as to prohibit the amateur from re-broadcasting on a 200-meter wave. It should, however, be mentioned that *this is only a rule. It is not a law.* In other words, there exists today no law, and the Radio Act of 1912 does not state anywhere that the radio amateur shall not give phone broadcast if he chooses to do so.

But it is realized that for the good of radio, we must all submit to the rules of the authorities, until such time as the Secretary of Commerce, realizing a great demand for such a service, will allow amateurs and others to so relay broadcast. We would suggest to all those who desire to re-broadcast broadcast to send a letter to the Secretary of Commerce advising him of their desire to establish a radio service in their respective communities.

As the letter from the Department of Commerce states, as soon as the Department is clothed with more power, there is no question that the rules will be made much more flexible than they are today, and we shall then be in a position to re-transmit broadcast by radio, as outlined in our December editorial.

It should always be remembered, and this is the gist of that editorial, that such re-broadcasting is only for isolated centers. It should never be attempted within 50 miles of a broadcasting station, if at all possible. This would give rise to interference, which might be very undesirable. On the other hand, we must also caution amateurs that *a scheme of this kind can be attempted only by an expert amateur*, who knows all the pitfalls of re-transmission of programs. The reason is very simple: When you make a copy of something, the copy is never as good as the original. When you typewrite a letter, the original is always better than the carbon copy. In other words, in making a copy, there is always a loss, as a rule. Radio is no exception to this. You may receive with an excellent set, and get wonderful results, but if you re-broadcast a program, something is lost. There is static interference, which is thus multiplied. There are other noises which are also multiplied. Thus even an expert relaying broadcast will often be disappointed at the quality of the relayed product.

It should be realized, however, that a community far removed from a large broadcasting station would probably be satisfied to receive the entertainment, even if it were not 100 per cent. perfect. This would be better than nothing at all, and the populace today realizes that Radio is, as yet, young, and they do not expect too much of it. When the phonograph and the automobile were young, we knew just exactly what to expect from them, and it is no different with Radio.

Since writing the editorial, another phase has come up, which puts an entirely different aspect on relayed broadcast. In awarding the first prize to Mr. L. W. Grundy, in our $500.00 Prize Contest, this prize was mainly given for the suggestion that AMATEURS SHOULD RELAY BROADCAST ENTERTAINMENT OVER THE ELECTRIC LIGHT LINES.

Here, then, we have the means that can be attempted at once by the technical amateur, but we must caution him again that *the ordinary individual should not attempt it*, under any circumstances.

In the first place, by relaying the entertainment over the electric light lines, *such relaying does not come under the ban and regulations of the Department of Commerce*, because we do not radiate into space, but over the electric light line system. While there are, of course, patents on the "wired wireless," as it is termed, we state under very good authority that the owners of these patents will, for the time being, not interfere with amateurs if they choose to relay broadcast over such light lines, particularly if they do not commercialize it; that is, by renting out receiving sets. In other words, a first class amateur in a small town can become a force in that community if he gives the populace free radio entertainment over the electric light lines.

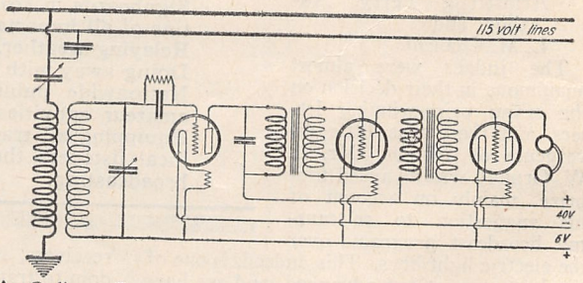
Not only this, but the quality of the entertainment, as re-broadcasted over the electric lines, is vastly better than if the entertainment were radiated into space, to be received by the distant listener over an aerial. In the "wired-wireless" scheme, the amateur sends the relayed entertainment over the light lines, while the distant user simply plugs into the line by means of an ordinary condenser plug, and receives the entertainment better than if an ordinary aerial were used.

Mr. R. D. Duncan, Jr., whose article, "Broadcasting By Wired Wireless," appeared in the December issue, is preparing an article for our next issue, giving all the technical data on how this relaying scheme can be used by the technical amateur.

Mr. Duncan, Jr., was an associate of Major General Squier, the inventor of "wired wireless," and has had vast experience in sending radio over wires in Washington, D. C., Cleveland, and New York.

The following is mainly an answer to many correspondents who wanted to have some further data on how to relay broadcast.

So many thousands of letters were received in connection with this editorial that we found it utterly impossible to reply to them all, and we hope that this data will answer all the questions:



An Ordinary Tuner With Amplifier is Used for Receiving Signals Sent Over the Light Line.

HOW TO RE-BROADCAST BROADCAST PROGRAMS

The re-broadcasting on another wavelength of the programs sent from broadcasting stations is possible, but let us say here that in order that the scheme be successful, it is necessary that a skilled operator

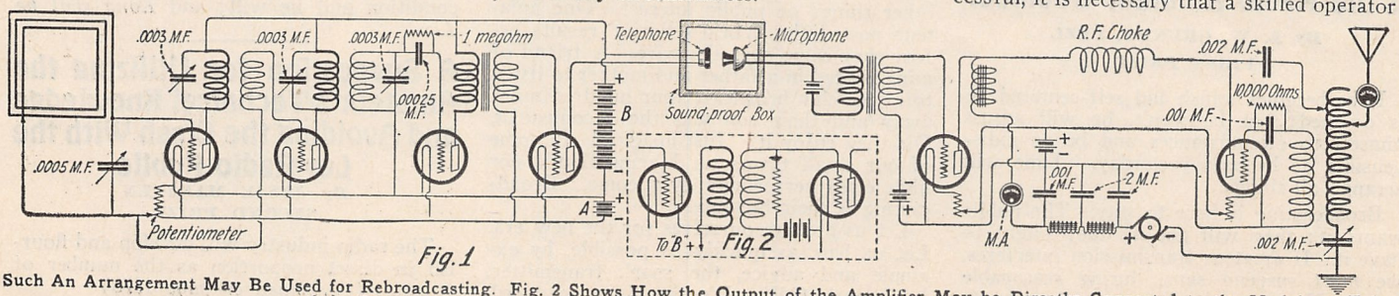


Fig. 1

Such An Arrangement May Be Used for Rebroadcasting. Fig. 2 Shows How the Output of the Amplifier May be Directly Connected to the Modulator Tube of the Transmitter. In the Latter the Negative Side of the Filaments Should be Grounded.

Radio Scheme

be in charge of the apparatus and that the station be installed by an expert having a great deal of experience in handling and tuning radio transmitters and receivers.

Supposing that a special license can be obtained for the re-broadcasting of musical programs on a shorter wave-length than that used at the present time, it would be necessary to use a loop aerial with a radio frequency amplifier so as to receive the programs to re-broadcast, as clearly and free from interference and static, as possible. The radio frequency system of amplification should preferably be of the tuned type so as to minimize interference from other broadcasting stations sending on almost the same wave-length, which would interfere greatly with the clear reception from a certain station. Only one or two stages of audio frequency amplification should be used so as to reduce to a minimum the noises which are amplified more by that type of amplifier.

Coated filament tubes of low internal impedance used with amplifying transformers of rather small ratio, not exceeding 3 to 1, would be best for the purpose, as with such an amplifier, all the frequencies which it is necessary to amplify will be reproduced with maximum clearness. It is essential that no distortion be caused by the receiver, otherwise, the retransmitted program would be absolutely ununderstandable when ultimately received. Right here is the question whether it would be best to connect the amplifier directly to the modulator tube, or to use a reproducer of some sort mounted in a sound-proof box and close to a microphone. The second solution would offer the advantage that standard parts could be used throughout, but the best method can only be determined by experiment.

In any case, it would be advisable to retransmit the program from the nearest broadcasting station so that sufficient energy would be received to modulate efficiently the output of the transmitter. It would not be advisable to use a regenerative circuit in conjunction with a loop as this is one of the sources of distortion which is most difficult to eliminate. Radio frequency transformers of good design might be employed and so connected that the circuit does not oscillate; a potentiometer should also be used to cut out any oscillations which might be produced by capacity between leads or other parts of the circuit. The transmitting set may be of any type and power but care should be taken that the modulation be perfect. Either the Heising circuit or Master oscillator-amplifier system should give best results as it is possible with these circuits to obtain more modulation than when the microphone currents are applied directly on the grids of the oscillator tubes.

If possible, the receiving set, including the loop aerial, should be placed a certain distance from the transmitter. Under certain circumstances, it will be found necessary to place them quite a distance apart running a line from the receiver to the transmitter apparatus to convey the received signals to the microphone. A line enclosed in a conduit and grounded would be preferable as induction from nearby lines would be eliminated to a great extent.

Another method of re-broadcasting programs would be by means of wired wireless, if in town there exists an electric light distribution with outlet in every house. In this case, the apparatus used would be of the same type but instead of an over-head antenna, the light line would be used to carry the music and other entertainment all over the town. The receiving sets in this case could be plugged in a lamp socket by means of the attachments now on the market, simplifying the installation since no outdoor or other form of aerial would be used. The diagram of connections of such a system for both transmitter and receiver was shown in detail in the December issue of RADIO NEWS on page 1054 in the article by Mr. R. D. Duncan, Jr. It is reproduced herewith:

In order that the transmission be as pure as possible, it would be necessary that a D.C. generator be used with the proper filter system to eliminate entirely the hum which might be present. If A. C. stepped-up to the proper voltage is used, it would be imperative to design a very efficient filter for the same purpose, as in most cases, it is more difficult to get rid of the extra noises when this form of plate supply is used. In any case, it would be obsolutely necessary that lengthy experiments be carried out before trying to give any service to a community, as special technical difficulties would certainly arise when attempting to re-transmit a program from a broadcasting station. To make a success of such an attempt, the services of a radio engineer will probably be necessary to solve the numerous problems which present themselves when endeavoring to re-transmit radiophone communications.

DEPARTMENT OF COMMERCE,
BUREAU OF NAVIGATION,
WASHINGTON, D. C.

Mr. H. Gernsback, Editor,
New York, N. Y.

Sir:—

The Bureau has received your letter of the 6th instant further in reference to re-broadcasting by amateur stations and asking what a first class amateur would have to do in order to obtain permission to re-broadcast.

There is attached hereto General Letter No. 234 explaining fully the requirements necessary to broadcast.

As you perhaps know there is a bill now pending in Congress which it is hoped will receive favorable action early in the present session. This bill will give to the Secretary wider authority in the way of making regulations and will make possible a re-allocation of wave lengths and when this is accomplished it may be possible to provide a plan which will permit the amateurs to carry on broadcasting to a limited extent provided it meets with public favor.

Respectfully,
A. G. TYRER,
Acting Commissioner.

FROM DR. L. W. AUSTIN

NAVY DEPARTMENT, BUREAU OF ENGINEERING, WASHINGTON, D. C. U. S. NAVAL RADIO RESEARCH LABORATORY, BUREAU OF STANDARDS.

Replying to your letter concerning the proposal for popularizing radio, it is certainly an excellent idea, and will undoubtedly be a success, provided the modulation used in the secondary stations is sufficiently free from distortion. One of the chief troubles in the radio situation is the poor quality of music furnished from the smaller stations; therefore, if this condition can be improved by re-distributing the output of the high-grade stations, there ought to be a marked increase in interest in the smaller towns.

L. W. AUSTIN.

FROM DR. DE FOREST

Your suggestion for popularizing radio as expressed in your editorial in the December RADIO NEWS is one that merits approval. It is gratifying to see RADIO NEWS suggesting a plan that will put the benefits of radio communication in the possession of the inhabitants of the small towns and villages of America as well as in the farming and agricultural districts.

My own personal feeling in regard to the working out of your plan, however, is not entirely in accord with your suggestion that this matter be taken up by radio amateurs and the responsibility for this reproducing shouldered by them. Why not utilize the amateur interest in having such reproducing stations sponsored, if not indeed actually established, by the educational, religious and civic leaders of the various towns and villages or by the constituted authorities, themselves?

The people, themselves, are the ones to benefit by your suggested plan for radio extension. Let those particularly interested in radio, namely, the amateurs, give their united support to the plan of having the matter taken up by the representative business men as well as by the city, town and county officials.

LEE DE FOREST.

FROM PROFESSOR MORECROFT

I think the re-broadcasting idea mentioned in your editorial is an excellent one. It seems the most logical way of increasing the number of listeners for the powerful central broadcasting stations, which are able to get the better class of talent for their programs.

I shall be very much interested to see how the scheme works out in practice.

J. H. MORECROFT.

FROM COMMANDER HOOPER

NAVY DEPARTMENT, BUREAU OF ENGINEERING, WASHINGTON, D. C.

Receipt is acknowledged of your editorial *"Popularizing Radio."*

The editorial sounds practicable and interesting.

S. C. HOOPER.

FROM WILLIAM DUBILIER

The plan outlined in your article "Popularizing Radio" appears to have great possibilities and is worthy of careful consideration by all interested in Radio.

The ideal condition is one central station, but, until some technical improvement is made that will enable a very moderately priced set to receive from quite a distance, the plan suggested by you could be tried with very little expense.

The inherent difficulties in such a plan are obvious, but the suggestion is certainly worthy of careful thought.

WILLIAM DUBILIER.

FROM JOHN HAYS HAMMOND, JR.

The editorial which you have sent me regarding the stimulation of radio broadcasting seems to me to embody an excellent plan, provided that the real reaction to broadcasting is based on economic principles rather than on technical ones. My own belief is however, that the technical limitations of the radiophone, as it at present exists, may have had some influence with the public in its discouragement, but this is more specially due to the fact that music has been such an important part of broadcasting and the radiophone has to compete with the phonograph, which is now a fairly good instrument. However, for the transmission of lectures and general information and a thousand other uses, the radiophone stands without a competitor. I feel that its chief purpose is in connection with the distribution of news to the rural districts and I quite agree with you that the rural dis-

(*Continued on page* 1593)

Super-Regenerative Amplification

By WILLIAM M. SMITH

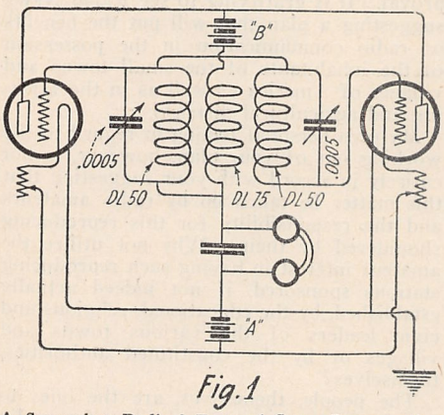


Fig. 1

A Somewhat Radical Type of Super-Regenerative Circuit in Which Multiple Tube Regeneration Takes Place

WITHIN the past few months a great advance has been made in the science of radio-frequency amplification. There has been opened before us a new and greater field of endeavor than at any other time since the introduction of the vacuum tube.

This is the era of inter-tube regeneration, or shall we call it multiple or compound circuit regeneration? It represents the next natural advancement after the era of inter-element regeneration (i. e. in which only one tube is used for regenerative amplification).

This new method of amplification may be divided into two distinct classes, viz.:

Firstly, the method employed in Major Armstrong's "super," whereby the amplification of an impressed E. M. F. is advanced to an extent far beyond the normal range of the tube by means of the sheer brute force of oscillations produced by an auxiliary circuit or some external means. This may be called the propulsive method.

Secondly, we have the retrocessive retroactive system of amplification in which amplification is attained within the circuit itself without the aid of an auxiliary circuit or externally produced oscillations. In this case it is a mere matter of "doubling up," so to speak. (See Figs. 1 and 1A.)

The difference between these two circuits is apparent although there is a theory of the "mode de operation" which may be applied to both of them, in fact to any regenerative circuit, namely: "The Theory of Negative Resistance."

At first glance it would seem that the old type of regenerative circuit should amplify an impressed E. M. F. to the full extent of the wattage of the tube. Such is not the case, however, because, as we are dealing with energy in a state of oscillation, there is an element of vital importance which must be considered in our calculations. This is the "Time element." It manifests itself by means of the retardation or impedence of the circuit to any impressed E. M. F. or alternating current. This will be best understood by reviewing the diagram in Fig. 2.

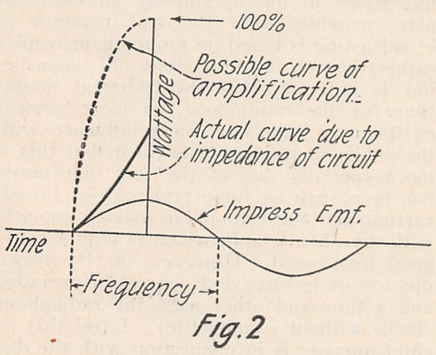


Fig. 2

A Curve Illustrating the Possible Amplification To Be Obtained in a Circuit of Zero or Negative Resistance

The above statement must also be said of the multiple circuits but this is compensated for in these circuits by two methods; firstly, as in the Armstrong "super," by directly increasing the voltage in the grid circuit by means of externally produced oscillations, and, secondly, as in the compound retrocessive regenerator by doubling up on the circuit and increasing the current in the plate circuit which in turn increases the potential in the grid coils.

The Armstrong "super" at its present stage of development is nothing for the layman to handle as it takes quite an expert to operate it, therefore we must find a circuit that will be easy for the layman to tune even though it is inferior to the "super" in final results. This simplicity of manipulation and construction is found in the double retrocessive retroactive circuit, which literally translated, means, "double-back-action circuit."

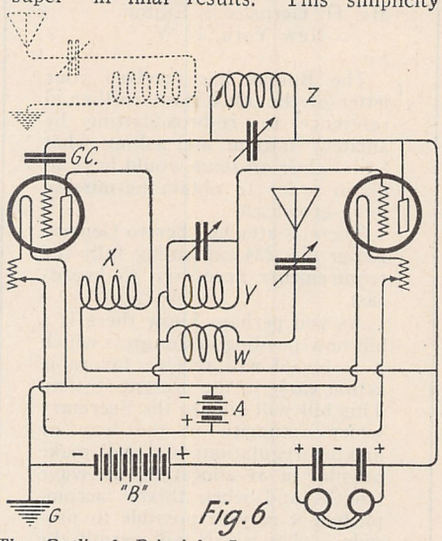


Fig. 6

The Outlined Principle Incorporated with the Ultra-Audion Circuit

The similarity of this circuit to both the simple regenerator and super regenerator is easily seen. Firstly, we have the "feed back" system, secondly, it makes use of two tubes, both of which function as amplifiers. And yet, notwithstanding that which has been said about the similarity of this circuit, we must place it in a class by itself as a distinct *type* of radio-frequency amplifier because of the reasons previously mentioned. When speaking of the results obtained we may place this circuit and its various modifications at points somewhere between both the super and simple regenerators. Under good conditions we may obtain results somewhat approaching those of the super regenerator with the circuit shown in Fig. 4, which we will discuss later.

The outstanding feature of the inter-tube regenerator in comparison with the simple regenerator is its range and selectivity. This is especially true when the grid inductances are in the position shown in Fig. 1. The diagram shown in Fig. 1A, while easier to tune, is not so exclusive to interference.

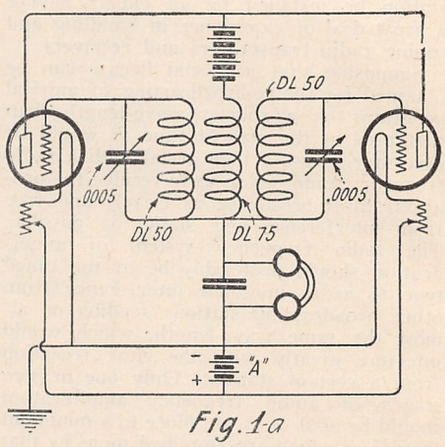


Fig. 1-a

A Further Adaption of the Circuit Shown in Fig. 1

Honeycomb coils are the inductances used. Those having sets using the familiar triple coil mounting may switch over to this hook-up in a few minutes, although it may be necessary to change the capacity of the condensers in some sets as only a maximum of .0005 Mfd. is necessary for a wave length range between 200 to 600 meters D. L. 35 was used for the 360-400 meter stations in both grid circuits (coils X-Y). The plate inductance depends on whether a loop or regular aerial is used.

When using a regular aerial I found that D. L. 25 to be about right. The aerial being simply connected to the plate side of the coil in series with a variable condenser (.0005 max.). With a loop 4 feet in diameter and having 15 turns I also used D. L. 25 with good results by simply shunting the loop across the plate coil. (The loop must be of greater inductance than the coil across which it is shunted.) By simply grounding the filaments I have no difficulty in picking up stations within a range of 500 miles, without an aerial of any kind (in this case the plate coil was D. L. 75) not so loud of course, but I do get them. The filament is always grounded regardless of the kind of aerial used.

In Fig. 3 we have a modification of this circuit adapting it to the use of variometers. This circuit is a vast improvement over the old type of regenerator, it being equal to about "det. and two step R. F." of the old hook-up.

Fig. 4 gives us a wonderful hook-up

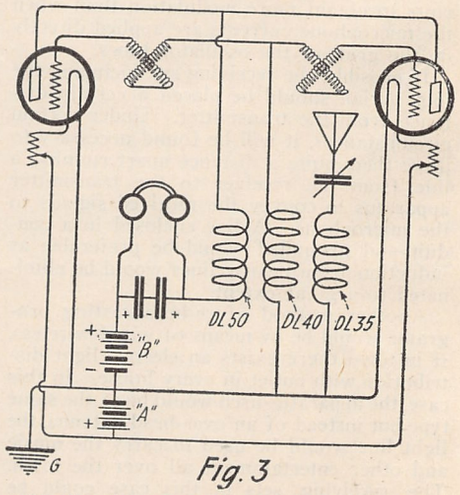


Fig. 3

A Modification of This Circuit to One Employing Two Variometers

for D. X. work. Using this circuit I can pick up San Francisco with ease, (from New York City). Station WEAF comes roaring in and with a Western Electric horn it nearly pushed the windows out. The tubes used on that occasion were U. V. 201's with 110 volts on the plates. I employed tuned inductances in place of the R. F. transformers shown in the diagram, but transformers simplify the tuning and should be quite as efficient. The grid coils X and Y may also be hooked up in the position shown in Fig. 1.

It is best to use a separate aerial circuit coupled inductively to one of the grid coils when using this hook-up (Fig. 4) in order to minimize re-radiation. When I was testing this hook-up I simply put the antenna on the plate side of the tickler and the filament went to ground, and as a result I had several of my friends tell me that they were receiving San Francisco on a crystal! One lived four blocks away. The time they gave me was synonymous with the time that I was testing the set.

Fig. 5 gives an excellent hook-up, using three tubes and two triple coil mountings. Very good results were obtained with this circuit.

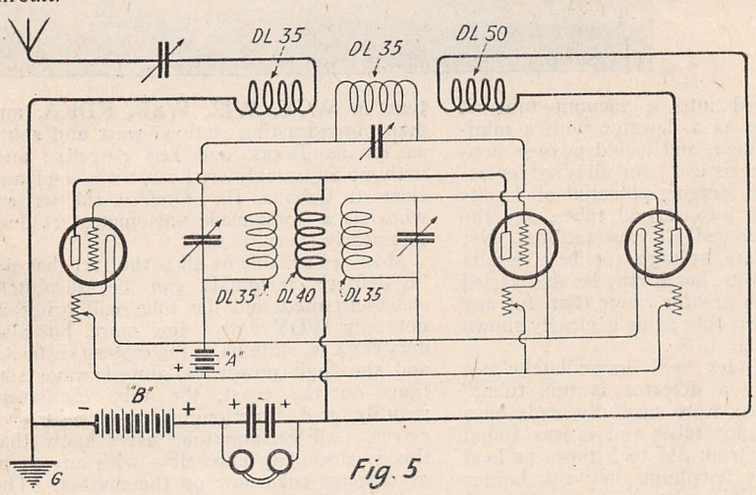


Fig. 5

A Hook-up Using Three Tubes and Two Triple Coil Mountings. The Same Theory of Operation is Applied

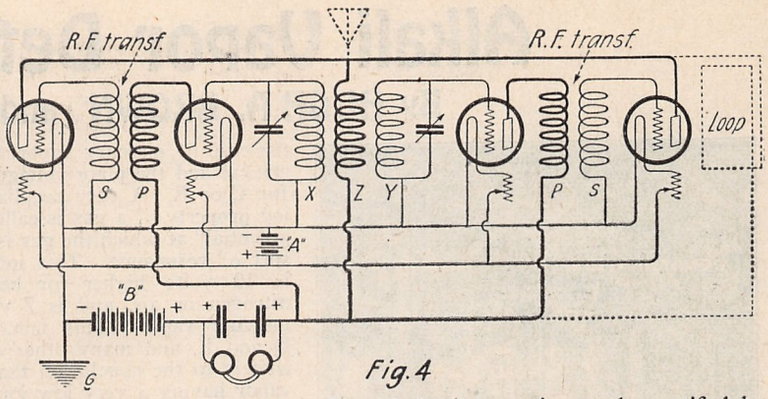


Fig. 4

A Good Hook-up for Long Distance Work. Radio Frequency Amplification in Conjunction with the Same System as Heretofore Described

The Ultra-Audion system is employed in the diagram shown in Fig. 6. Any number of tubes may be used with this circuit by employing R. F. transformers in place of the coils X. Y. The tubes being placed in cascade with coil Z, merely placed from the grid of the first tube to the plate of the last as shown in the drawing. Care must be taken to have the potential on the last tube of the proper sine, otherwise, instead of amplification you will have dimunition. If such is the case it may be rectified by reversing the connections of the secondary of the last transformer.

If the hook-up is used exactly as shown in Fig. 6, a triple coil mounting may be used for coils W, X and Y. Coil Z may also be inductively coupled to X. The values of the coils are: W, Y and Z—D. L. 35; for coil X—D. L. 50.

If the inductances X and Y are replaced by a radio-frequency transformer, the aerial circuit may be coupled inductively to coil Z in the manner shown by the dotted lines.

Excellent results were obtained by using coils X and Y alone, coil Z being a loop aerial of the proper size and inductance for the wave-length to which X and Y were tuned. All condensors used in this circuit were .0005 mfd. maximum, except the grid condensor, which was a fixed .00025 mfd.

The reader's special attention is called to the position of the phones in all of the above circuits. You will note that the plate current of all the tubes of each circuit must pass through the phones. This is a vital factor in producing volume; furthermore it keeps high resistance out of the oscillating circuit, which is almost imperative where regeneration is concerned. The phone condensers in all of the above circuits should be between .002 to .005, using two in series across the phone. The reason for having two condensers in series will be understood

(*Continued on page* 1572)

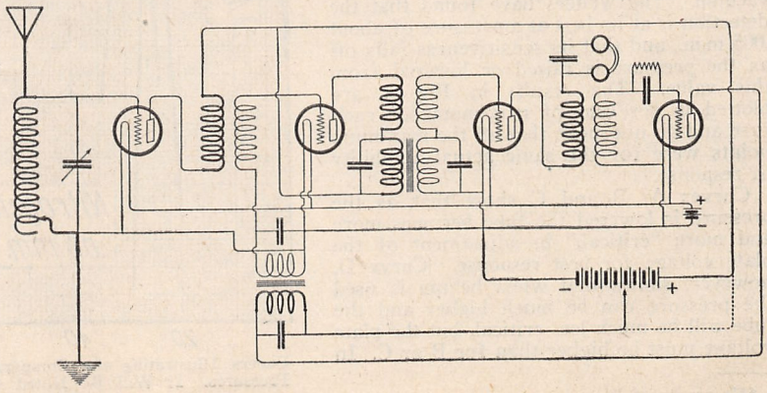
The Reflex Circuit

By J. L. GOLDSMAN,* I. R. E. A. I. E. E.

VERY much discussion has been carried on as to the practicability of the so-called reflex circuit—a circuit designed, developed and patented in April and November of 1917 by Mr. Marius Latour, a French radio engineer.

The circuit consists of four tubes, the first three acting as radio frequency amplifiers and coupled by radio frequency transformers, which are designed for limited wave-lengths, the last tube acting as a detector. After the rectification of the high frequency oscillations, the current is led back to the primary winding of an audio frequency transformer and thence to high voltage and the filament.

The secondary winding of the transformer is placed in the grid circuit of the second tube which consequently amplifies the audio frequency oscillations at the same time as the radio frequency. The latter does not pass through the secondary windings, but is shunted across a fixed condenser of approximately .002 mfds. The audio frequency currents are amplified by the second tube and pass through the primary winding of the second audio frequency transformer. The secondary winding of this transformer is in the grid circuit of the third tube. This tube also amplifies the audio frequency currents which flow through the telephones which are included in the plate circuit of the third tube. Fixed condensers are placed across both primaries and both secondaries of the audio frequency transformers to prevent the windings from interfering with the high frequency oscillations flowing simultaneous in the same circuit. This circuit is complex and difficult to control due mostly to capacity effects, etc. In lieu of the radio frequency transformers I substituted oscillation transformers (.0004 variable condensers and approximately .2 millihenry inductance). Better results were obtained. Great care must be taken to prevent understage radio frequency transformers acting as grid condensers and rectifying the high frequency oscillations before they reach the detector tube. This is common with many radio frequency sets on the market today. Atlanta Journal was heard in Toledo with this circuit using an aerial, but from all indications the standard five-tube radio audio frequency circuit is preferred where a loop is practical. Another circuit along these lines is now under test using only three tubes and with a few changes in wiring greater audibility has been obtained.

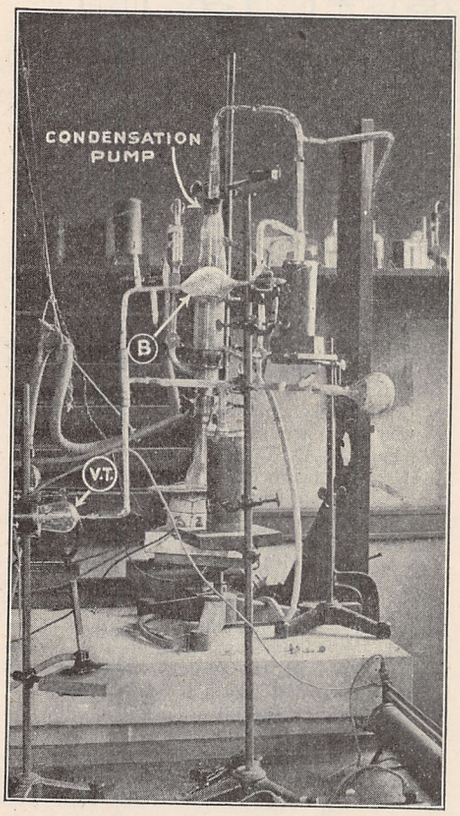


The Reflex Circuit Using Four Tubes. The Last One Acts as the Detector While the First Three Play Double Duty and Supply Three Stages of Radio Frequency and Two Stages of Audio Frequency Amplification.

*Chief Engineer, Lyradion Mfg. Co.

Alkali Vapor Detector Tubes

By HUGH A. BROWN* and CHAS. T. KNIPP*

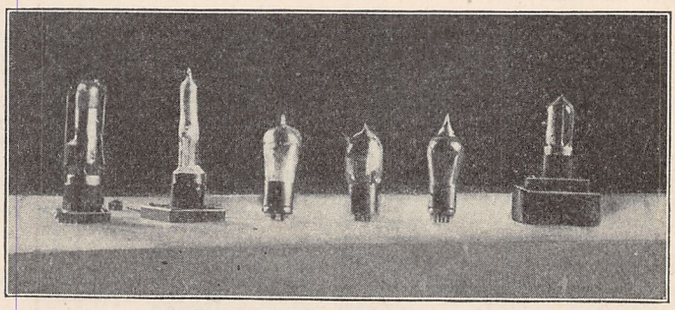


The Pumping Apparatus Used for the Evacuation of the Tubes

THE authors of this article have been conducting a laboratory investigation of gas content detectors during the past three years, and their researches have resulted in the alkali metal vapor detector and amplifier.

The curves Fig. 1 best show some of the results of a large number of experiments carried out by the writers, and will show some interesting things. When the vacuum is very high a high plate voltage is needed to produce maximum response to received signals as shown by Curve A. Note that at a pressure of .00012 m.m. of mercury, the plate voltage may be varied from 110 to 140 volts without changing the audibility of the response in the receivers. Fig. 1 should be studied carefully. When the pressure increases to .012 m.m., the gas being nitrogen, the plate voltage for maximum signal response is cut down from 110 to 28 volts. Also the grid voltage—plate current characteristic curves are steeper for the pressure of Curve B than for A. This means that the plate current and hence the signal response is greater for small changes in grid voltage for the lower degree of vacuum. The writers have found that the detection is at its best at a pressure of about .005 m.m., and that its sensitiveness falls off as the pressure is raised or lowered from this value. The results in Fig. 1 are plotted in per cent of maximum for each case and do not mean that all the maximum points were for the same actual audibility of response.

Curves A, B and C show that as the pressure is lowered the tube becomes more and more "critical," in adjustment of the plate voltage for best response. Curve D, however, shows that when helium is used the pressure can be much higher and the tube will be much less critical, but the plate voltage must be higher than for B or C. In the case of mercury vapor the tube is less critical and the plate voltage is lower than for C or B. A very peculiar and interesting property of a gas is called its "ionizing potential" at which the gas is thrown into a sort of resonance. This ionizing potential is 10 volts higher for helium than for nitrogen or air, and is 7 volts lower for mercury vapor. This fact, the curves C, D and E, and many other curves, led the writers to the conclusion that if a metallic vapor having a very low ionizing potential were introduced into a vacuum tube, it would function as a detector with a minimum plate voltage, and would possess non-critical characteristics. An alloy of potassium having an ionizing potential of 4 volts was introduced into several tubes, and the results far exceeded all expectations. Not only is the plate voltage for best results about 8 to 10 volts, but it may be also varied through a much greater range than for any other gas content tube; this is clearly shown in curve F, Fig. 1.



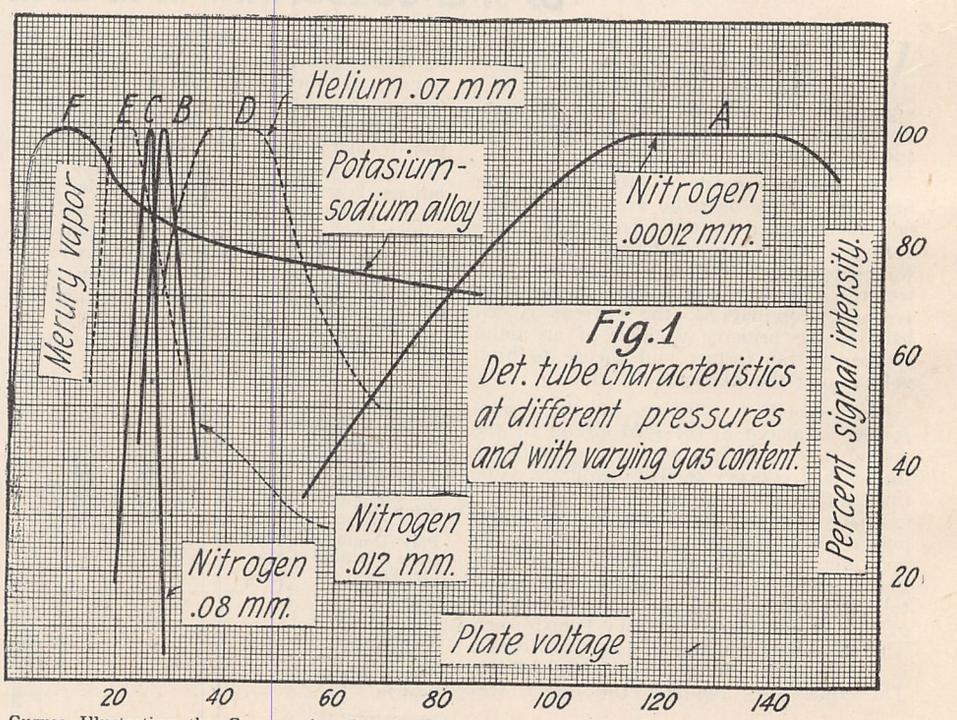
A Series of Standard Tubes Which Have Been Refilled with Alkali Vapor for Experimental Purposes

But the reader will immediately ask, "How sensitive a detector is this tube?" Comparison tests were carefully made on a dozen alkali vapor tubes and it was found that they gave from 3½ to 5 times as loud response in the telephone on weak buzzer modulated C. W. received currents, and damped wave currents than did similar tubes used as gas content detectors. This comparison was made with a plate voltage ranging from 8 to 10 volts (plate circuit return to negative to negative filament) for each of the alkali vapor tubes and for plate voltages carefully adjusted for best results in the case of the gas content tubes used for comparison. The directly measured audibility of the received currents was 5.5 times on a standard tube, which represents a pretty weak signal.

It is a pleasant experience to place one of these tubes in a variometer type regenerative receiver, or a Westinghouse receiver and using two dry cells for plate voltage tune in WGY, WJZ, WSB, KDKA, and many broadcasting stations west and south as far as Texas, and Los Angeles; and, without any amplifier, hear them loud and clear at Urbana, Ill. One of the writers who has a home-made variometer set does this nearly every night.

Most remarkable of all is the fact that the "B"-battery terminals can be absolutely short circuited and the tube will bring in not only WGY and a few more, but also amateur c.w. stations in the eastern districts, and the high power undamped wave stations on the coast, the tube oscillating steadily, and functioning as a "beat" receiver. All vacuum tube users know that this is absolutely impossible with any form of detector tube now on the market. The writers investigated the characteristic curves, and variation of output coefficient of some of these tubes, and found to their astonishment that the curves are smooth and

(*Continued on page* 1566)



Curves Illustrating the Comparative Results of Tubes Containing Different Vapors at Varying Pressures. It Will Be Noted that Tubes Containing Potasium Sodium Alloy Give Maximum Signal Intensity at Comparatively Low Plate Voltages.

*University of Illinois.

Radio Frequency Measurements

By L. R. FELDER

Part 1

IN the January, 1923, issue of RADIO NEWS the writer described the design and construction of a C. W. Oscillator for measurement purposes. With this oscillator almost every conceivable type of practical radio measurement can be made. Every amateur who runs an efficient station has occasion to make numerous measurements, and in fact many measurements are absolutely essential if the amateur does not want to be in the dark concerning the performance of his station. This article

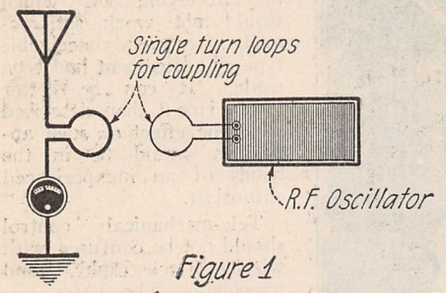


Figure 1

Circuit Employed for Measuring the Fundamental Wave-length of An Antenna.

will illustrate the various radio frequency measurements which the writer had occasion to make, the methods, and the precautions to be observed in making these measurements.

ANTENNA MEASUREMENTS

MEASURING FUNDAMENTAL WAVE-LENGTH OF THE ANTENNA

A knowledge of the fundamental of the antenna is of first importance to every intelligent amateur, as this factor is the starting point of his set, and his different designs are more or less based on this. Fig. 1 shows the hook-up employed in this measurement. In all diagrams in this article showing the R. F. oscillator the symbol shown in Fig. 2 will be employed for the sake of convenience. The antenna is unloaded and is coupled to the oscillator coil by means of a single turn loop. This loop is not added to the antenna proper, as this would result in a higher wave length than the fundamental, but the lead in may simply be turned into a small loop which is coupled to the oscillator. A small lamp or R. F. milliammeter is inserted in the ground lead. Start the oscillator and the oscillations induced in the antenna will light the lamp or be indicated on the milliammeter. Vary the condenser of the oscillator until lamp lights up to maximum brilliancy,

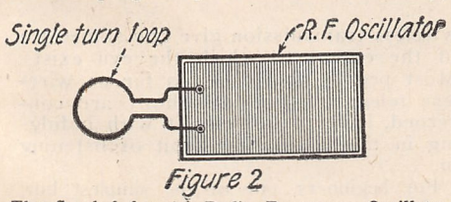


Figure 2

The Symbol for the Radio Frequency Oscillator Used Throughout This Article.

or until ammeter indicates maximum. The wave length, corresponding to this reading of the condenser will be the fundamental of the antenna.

MEASURING CAPACITY OF THE ANTENNA

The hook-up employed for this measurement is shown in Fig. 3. A very large inductance coil is placed in the ground lead of the set in series with the lamp or the milliammeter. The value of this inductance should be known. The oscillator is started and coupled to the antenna as before by means of a single turn loop, whose inductance will of course be negligible compared to the large inductance L. The variable condenser is varied until the ammeter in the antenna circuit indicates the resonance condition. The wave length of the antenna circuit will then be indicated by the oscillator. Knowing the wave length of the antenna and the value of the loading inductance the capacity of the antenna may then be obtained from the formula:

$$\lambda = 60\sqrt{LCa}$$

$$\therefore Ca = \frac{\lambda^2}{3600L}$$

In this measurement it is essential that the loading inductance L should be sufficiently large to make the wave length of the loaded antenna at least about four times that of the fundamental of the antenna, otherwise the accuracy of the measurement will be affected by the inductance of the antenna. The inductance of the antenna being generally very small, if the loading inductance is large enough, the small inductance of the antenna may be neglected without hurting the accuracy of the measurement. The accuracy of this measurement depends upon the accuracy of the wave length measurement. Assuming that the oscillator is properly calibrated the main source of error that can arise is due to tight coupling and the development of coupling waves. It is for this reason that very loose coupling in the form of a single turn must be employed.

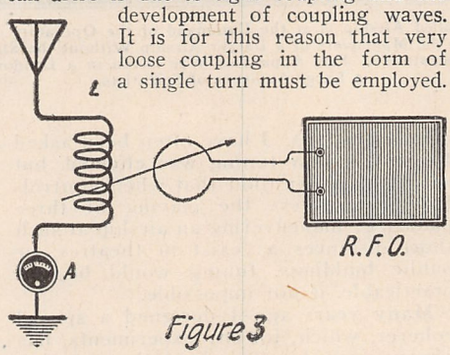


Figure 3

The Hook-up Used for Measuring the Capacity of An Antenna.

Otherwise due to the coupling waves which result there will be an error in the wave length measured and hence an error in the measured capacity.

MEASURING INDUCTANCE OF THE ANTENNA

From the above two measurements we know the capacity of the antenna and the natural wave length. From these two factors we are able to calculate the inductance of the antenna from the usual wave length formula. Obviously the accuracy of this inductance value thus obtained will depend entirely upon the accuracy of the two previous measurements. Hence the precautions mentioned above should be scrupulously observed if reliable results are desired.

GENERAL CAPACITY MEASUREMENTS

There are a number of different methods of measuring the capacity of a condenser but each method is particularly suitable for a definite size capacity, that is, will give most accurate results. Thus it is obvious that the capacity between a pair of telephone cords which is extremely low could be measured by the same method which is used for the capacity of a telephone condenser which is quite high, but the accuracy of the measurement would not be good at all. Such low capacities as that between telephone cords have a method of measurement which is highly accurate and slightly different from the other methods. These will be considered separately.

(*a*). *Measurement of medium capacities.* The method employed for these capacities. which are the capacities generally used in variable condensers, such as 0.001 mfds. is the basic of all methods and will therefore be considered first. It is practically a substitution method and requires a known capacity. Figure 4 shows the circuit connections used in this measurement. The R. F. oscillator is coupled very loosely by means of a single turn to a circuit consisting of an inductance coil whose value need not be known, the resonance indicator "A" which may be a glow lamp or milliammeter, a

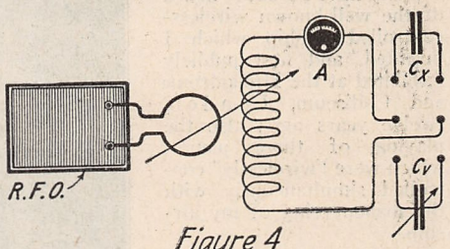


Figure 4

For General Capacity Measurements, the Layout Shown Above is Desirable.

double pole double throw switch connected as shown to the known variable condenser Cv and the unknown condenser to be measured Cx. The switch is thrown so that the unknown condenser Cx is connected in circuit and the oscillator condenser varied until resonance in both circuits is obtained as shown by maximum indication on A. The switch is now thrown so that the known variable condenser is in circuit. The oscillator is kept at the same position and the variable condenser Cv is varied until resonance is again secured. Since no conditions have been changed except the variable condenser Cv and the wave length of oscillations kept constant, it follows that

$$Cv = Cx$$

Since the variable condenser Cv is calibrated we know the value of the unknown condenser.

(*b*). *Measurement of small capacities.* The difficulty in the measurement of small capacities is that sufficiently small standards may not be available. Very few stations have standard calibrated condensers of the size, for example, of the capacity between

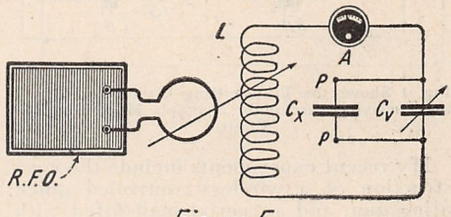


Figure 5

This Circuit is Used for the Measurement of Small Capacities.

a pair of telephone cords. It is therefore necessary to use a so-called "differential" method. The principle involved in this measurement will be understood by considering Fig. 5, which is the circuit hook-up for the test. Here the R. F. oscillator is again coupled to the measured circuit by means of a single loop. L is an inductance whose value need not be known, but which should be able to tune with the variable condenser to the wave length of the oscillator. "A" is again the resonance indicator, Cv

(*Continued on page* 1508)

Radio Control

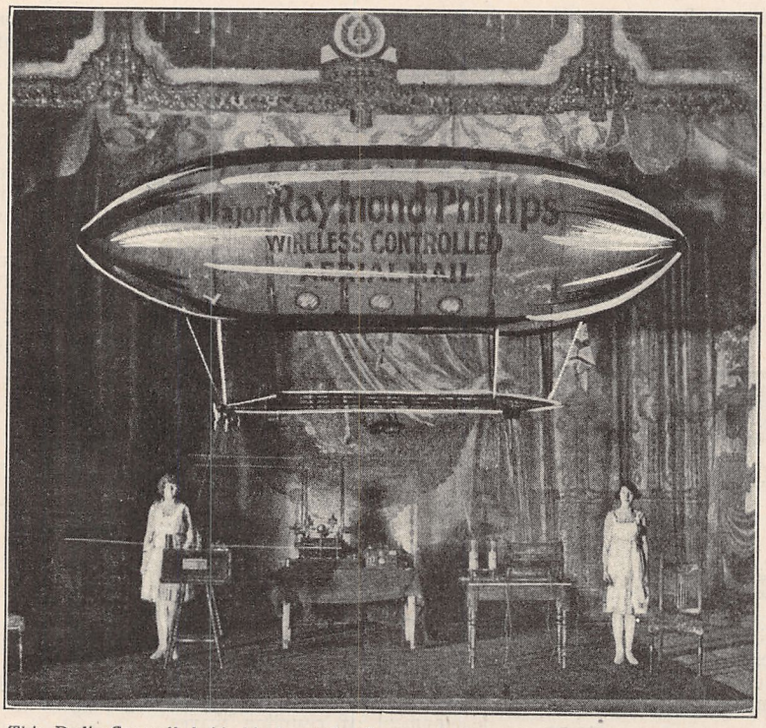
By Major Raymond Phillips, I. O. M.

THE control and operation of mechanism by means of wireless waves open up a field with vast possibilities, and a remunerative harvest for the successful experimenter.

Tele-mechanical control has engaged the attention of scientists for many years, and experiments have from time to time been made in connection with the wireless control of torpedoes, boats, etc.

Many have no doubt heard of the well-known wireless-controlled airship which I invented, and first publicly exhibited at the Hippodrome and Colliseum, London, twelve years ago; also the playing of three pianos, which were "wirelessly" controlled simultaneously with the maneuvering of my airship.

The magnitude of the latter fact created much comment, and the late Professor Silvanus P. Thompson, F.R.S., examined my apparatus, and subsequently issued a certificate to the effect that it was a genuine example of wireless control.



This Radio-Controlled Airship is at the Command of the Operators on the Stage. It Goes Through All the Maneuvers of a Larger Airship Without the Slightest Difficulty. The First Demonstration of This Apparatus Was Given in a London Theatre Before a Large Audience of Scientists.

These demonstrations naturally caused a sensation at the time, when wireless telegraphy and aviation were practically in their infancy.

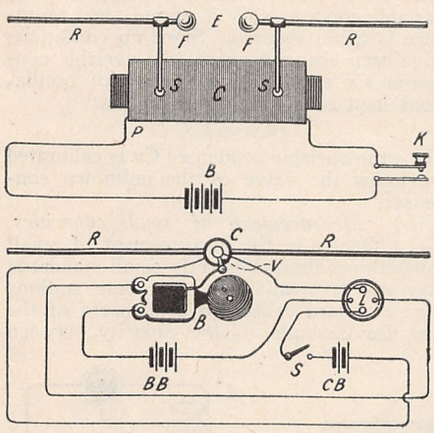


Fig. 1 Shows the Transmitting Circuit and Fig. 2 the Peceiving Circuit for a Simple Method of Bell Control.

My recent experiments include the construction of a wireless-controlled quick firing gun, and an aerial mail fitted with a syren, thus showing that the scope for experimenters is practically unlimited.

It is my intention to write a series of articles giving details of experimental apparatus suitable for wireless control, and based upon my own practical experience with such work.

I shall only give details of experimental apparatus with a range of not more than 50 yards when used in conjunction with a modified Hertz spark coil for transmitting purposes.

It may probably surprise many readers when I state that I never fitted tuning devices to any of my tele-mechanical controlled apparatus used for public demonstrations. I have often been asked to explain how tuning was effected, but it will be understood that when controlling by wireless the playing of three pianos, or maneuvering an airship at such short distances as exist in theatres, or public buildings, tuning would be impracticable, if not impossible.

Many years ago I designed a special coherer, which, for my experiments, has always proved more reliable in its action than the glass tube type. The latter, apart from its liability to breakage during decohering, generally needs very fine adjustment in conjunction with a potentiometer, and it will be realized that experimental apparatus used for public demonstrations must not only function perfectly, but also without difficulty, especially in the case of a wireles-controlled airship, where it would not be possible to effect adjustments once such a craft is in flight.

In my system of direct and ordinary selective control, some of the circuits are complicated. A reliable coherer is therefore imperative. A good relay is equally important.

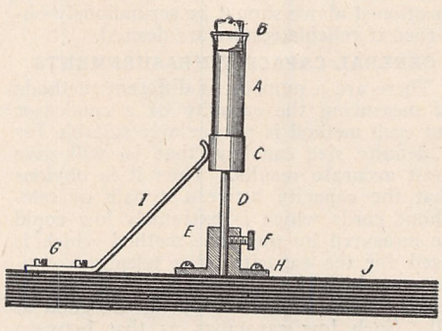


Fig. 4.—A Vertical Type of Coherer Containing a Mixture of Nickle and Silver Filings.

Those who contemplate experimenting with the wireless control of mechanism will be well advised to use only the best appliances. Do not be led away by offers of cheap apparatus and then expect results which can never be justified.

I have many times examined so-called "Laboratory Receiving Sets" which would not work satisfactorily after every conceivable type of adjustment had been made. It can be better imagined than described what the effect of such apparatus would be in the hands of an inexperienced enthusiast.

Tele-mechanical control should not be confused with wireless telegraphy, and telephony. The latter science involves the use of extremely sensitive and delicate devices, which would speedily be put out of action if applied to relay control of mechanism subjected to vibration. These, and other difficulties, will, no doubt, be overcome in time.

A Simple Experiment

Jamming, i. e., interference from other transmitting stations, is of course, a contingency always to be reckoned with. The present restrictions in regard to

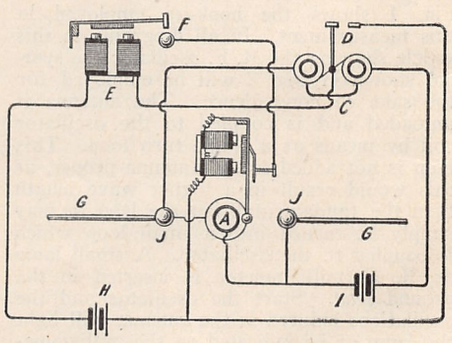


Fig. 3.—A Simple Circuit for Use With the Coherer Shown in Fig. 4.

wireless transmission give one some idea of the extent to which the evil exists. Most people, therefore, so far as wireless telegraphy and telephony are concerned, have to be content with indulging in the fascinating habit of listening in.

For beginners, one of the simplest but, perhaps, most popular experiments with tele-mechanical control, is wireless control of an ordinary electric bell fitted with a 4″ or 6″ gong. All the apparatus necessary for such an experiment can be neatly mounted upon suitable base boards, and when properly constructed the set will be found useful in a house or office where it is desired to communicate between rooms, thus avoiding the necessity of running insulated wires, as would be the case in connection with the installation of an electric bell in the ordinary way.

The transmitting and receiving circuits

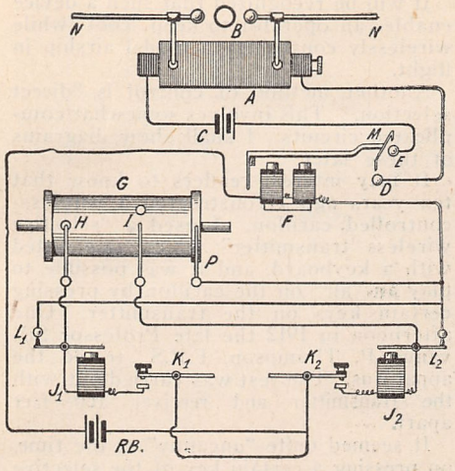


Fig. 6.—Transmitting Apparatus Used in Conjunction With the Radio Controlled Carillon.

for such a simple method of bell control could be arranged as shown in Figs. 1 and 2.

The transmitter, as shown in Fig. 1, consists of an induction coil C with primary and secondary terminals marked PP and SS (the trembler and other circuits of the coil are purposely omitted for the sake of simplicity), an ordinary telegraph key K, a large brass ball E, and two rods RR (which represent an aerial), at the ends of which are brass balls FF.

For satisfactory experiments over short distances it is advisable to construct the transmitter with an induction coil which (when its primary circuit is connected to a battery with an E.M.F. of 4 volts) can produce a spark one inch long between two small metallic balls attached to the end of its secondary circuit.

The two rods RR should be mounted upon insulated supports and should preferably be of aluminum or brass tube, 30″ long by 3-16″ diameter. The brass balls FF and E should be highly polished, the former ½″ diameter. The latter 1″ in diameter should also be mounted upon an insulated support. Arrangements should also be made for the rods RR to slide in their supports so that the distance (normally ⅛″) between the ball E and balls FF may be adjustable.

It will be observed that an inductance is not included in the transmitter or receiver circuit for reasons already explained.

The receiver, as shown in Fig. 2, consists of a large electric bell B, as relay L, coherer and support C, switch S, coherer battery CB, bell battery BB, and two rods RR.

For this experiment it is advisable to use a good quality electric bell fitted with a 4″ or 6″ gong. The hammer of the bell should be drilled and tapped, and a circular piece of vulcanized fibre, ½″ long by 3-16″ diameter fitted to same as marked "V" in Fig. 2.

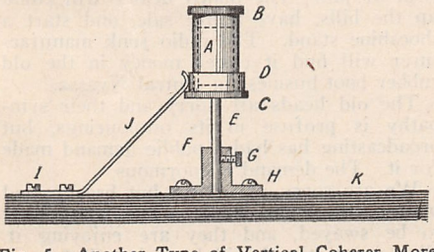


Fig. 5.—Another Type of Vertical Coherer More Rugged in its Construction.

It will be observed that the object of fitting the circular piece of fibre is to enable the bell hammer on its return stroke to strike the coherer C, thus effecting decohering. The bell may of course, be either "single stroke" or "trembling," the latter, perhaps, making the more "showy" demonstration.

Any suitable coherer and relay may be tried for this experiment, but in subsequent articles I purpose giving details of the coherer and relay which have been used with such success in connection with my public demonstration.

The switch S may be of any simple type. The two rods RR should be the same length as those fitted to the transmitter, and preferably of the same type.

Any suitable dry battery may be used in connection with the coherer and bell circuits of the receiver.

An ordinary 3½-volt pocket lamp battery was sufficient to work a wireless-controlled electric bell which I constructed many years ago.

Having now shown what a simple matter it is to construct the apparatus illustrated in Figs. 1 and 2, I shall give details of more complicated circuits for "direct" wireless control of mechanism without the necessity of selecting in sequence.

A coherer is generally classified as an "imperfect contact detector," and though now obsolete for the detection of wireless telegraph signals, it still has many advantages for the control of mechanism at short distances.

It seems curious that, although so long ago as 1835 it was discovered that the passage of a high-tension electric discharge through a loose mixture of metal filings rendered the latter conductive to electric currents, it was apparently not until 1890 to 1896 that the discovery attracted sufficient attention to cause serious experiments to be conducted in connection with wireless telegraphy. The term "coherer" appears to have originated from a theory that incident wireless waves caused the filings, or particles of an imperfect contact detector, to "cohere." There may probably be some truth in such a theory, as the art of "tapping" a coherer causes the filings, or particles contained therein, to decohere, thus restoring such into a non-conductive condition.

As the "tapping" device involved complications, it led to a number of inventions for "self-restoring" imperfect contact detectors. The latter appeared to need such extremely fine adjustments, that at the time the coherer with "tapper" held the field.

In the construction of a coherer for tele-mechanical control the first consideration is certainty of action.

Large contact surfaces tend to make a coherer very sensitive, but sometimes "sluggish" in decohering. Such a detector for experimental apparatus would be a source of annoyance when connected with a relay, on account of its tendency to develop "pumping" in the latter. The smallest electric current possible (consistent with efficient working) should be permitted to pass through the filings and contacts of a coherer.

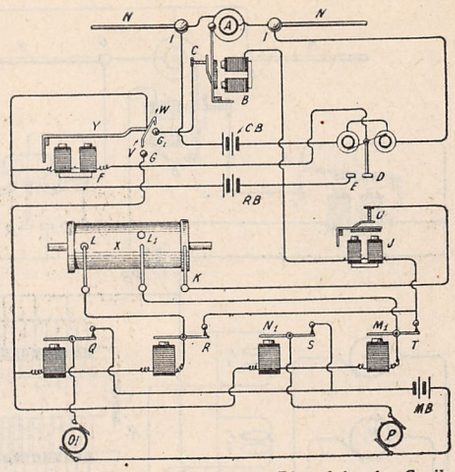


Fig. 7.—Receiving Apparatus Placed in the Carillon for its Control.

The "selective controller" attached to the wireless controlled airship, as described in the specification of my British Patent No. 6316 of 1910, was at first fitted with a vertical type of coherer as shown in Fig. 4. It consisted of a glass tube A, plug B, brass cap C, supporting rod D, base E, clamping screw F, terminals G and H, also contact spring I, the whole being mounted upon a non-conducting base J.

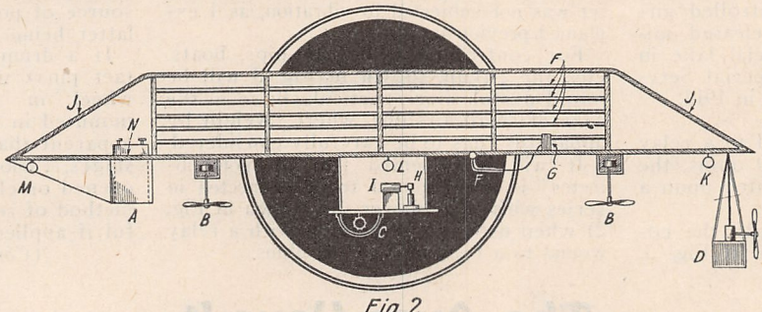


Fig. 2

Fig. 8.—The Construction of the Framework and Position of the Apparatus is Clearly Indicated. It is Secured to the Balloon by Eight Light Cords.

The interior contacts of the coherer are connected to the exterior of the cap C, and supporting rod D; a mixture of nickel and silver filings being contained in the glass tube A.

This coherer proved more reliable than the "horizontal" glass tube type, but strenuous conditions called for a more substantial detector, which led me to design the coherer as shown in Fig. 5. It consisted of a vulcanized fibre tube A, screwed plugs B and C, contact ring D, supporting rod E, base F, clamping screw G, terminals H and I, and contact spring J. The whole being mounted upon a non-conducting base K.

The interior contacts of the coherer are connected to contact ring D and supporting rod E; a mixture of nickel and silver filings being contained in the vulcanized fibre tube A.

This coherer proved most reliable, and useful for experimental apparatus. Its sensitivity could be adjusted to a nicety by simply unscrewing the plug B and adding or removing filings as desired; while the interior contacts could be examined without removing the filings by

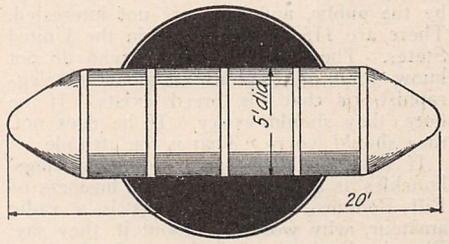


Fig.1

Fig. 9.—The Balloon of the Airship. Hydrogen Gas is Used to Give it Lifting Power.

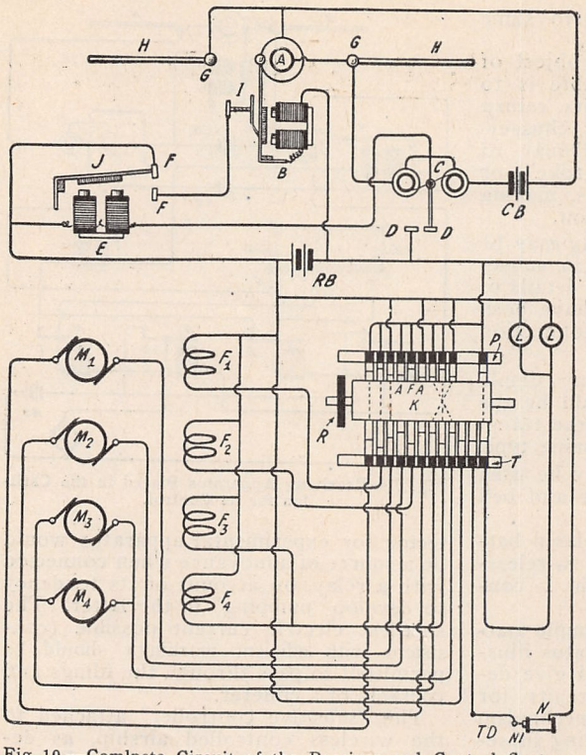


Fig 10.—Comlpete Circuit of the Receiver and Control System of the Airship. Relays Actuate the Rotary Selector Switch, Which in Turn Controls the Four Motors

unscrewing the plug C, while holding the device with the supporting rod E pointing upwards.

This coherer has been used in connection with all my experimental apparatus, and was fitted to the selective controller attached to my wireless-controlled airship, which during its flight released imitation bombs over the artificial lake in the Empress Hall, at the Imperial Services Exhibition, Earl's Court, in 1913.

A Simple Circuit

The coherer was connected to a relay wound to a resistance of 100 ohms, the armature of which was mounted upon a vertical pivot.

A simple circuit for use with the coherer just described is shown in Fig. 3. It consists of the coherer with base A, decohering device B (which is similar to an ordinary electric bell with gong removed), relay C, relay contact D for closing the circuit connected with the electromagnet E (which may, for example, operate "step by step" mechanism), contact F for closing the circuit connected with the decohering device B, G G, metallic rods (which represent an aerial) H, relay battery I, coherer battery J J, insulated supporting pillars for rods G G.

In operation it will be observed that on the coherer A detecting a wireless wave, current from the battery I will energize the relay C, closing contact D, thus admitting current from the battery H, which will energize the electro-magnet E, closing the contact F, and causing the de-cohering device B to tap the coherer, which latter would then be restored for detecting further wireless waves.

If the electro-magnet E were to operate "step by step" mechanism the system would be "simple selective control," i.e., control by "sequence."

If the coherer A and rods G G were removed, and the contacts of a very sensitive relay (forming part of one of the latest valve receiving sets for tele-mechanical control) were connected with the points J J, it would be possible to control the electro-magnet E from a considerable distance, provided the valve receiving set was not subjected to vibration, as I explained previously.

For controlling model airships, boats, etc., the circuit shown in Fig. 3 will be found useful, more particularly so in the case of small airships, where "weight by apparatus" has to be carefully considered.

It will be observed that a "potentiometer" is not required to be connected in series with the coherer (as shown in Fig. 2) when used in conjunction with a relay wound to a resistance of 100 ohms.

It will be recognized that such a device enables an operator to keep "cool" while wirelessly controlling a model airship in flight.

Another method of control is "direct selection." This involves somewhat complicated circuits. I shall show diagrams of these later.

It may interest readers to know that ten years ago I constructed a wireless-controlled carillon. I used a "selective wireless transmitter" which was fitted with a keyboard, and it was possible to play an "air" on the carillon by pressing certain keys on the transmitter. One afternoon in 1912 the late Professor Silvanus P. Thompson, F.R.S., tested the apparatus. The test was carried out with the transmitter and receiver 100 feet apart.

It seemed quite "uncanny" at the time, on pressing a certain key of the selective wireless transmitter, to observe the corresponding bell note, and that note the only sound in the receiver.

I mention this experiment merely to indicate the vast possibilities open to wireless enthusiasts.

I intend explaining now simple "selective wireless control," and at the same time to give details of my methods of "direct selective control." The latter system was adopted in connection with the construction of my "wireless-controlled corillon."

I referred to "selection by sequence," or "simple selective control," such as would be found in a "step by step" movement. For instance, a ratchet wheel may be caused to revolve in desired stages, by means of impulses from a pawl attached to an armature attracted by the pole pieces of an electro-magnet; the source of power used for energizing the latter being wirelessly controlled.

If a drum (suitably studded with contact pins) was attached to the ratchet wheel in question, and the whole mounted in a suitable manner, it will be apparent that, by revolving the drum in stages, various electric circuits could be opened or closed at will. Such a simple method of selection would be found useful if applied to the control of mechan-

(*Continued on page* 1492)

The Ayes Have It

By JACK BRONT

GRIM fingers are pointing toward the elimination of the amateur telegraphist. By the latter is meant the lad from fourteen to forty, who used to sit up nights and rasp on his sixty-cycle rockcrusher, or his shrilly complaining squeak tube, reaching out to cover the kilometer, between Squeedunk and Kalamazoo.

The amateur telegraphist is of no visible utility to the public. He has labored long and industriously far into the night under shaded lamps, unseen, unheard, and unsung in the eye of the general public. John Smith, who communicates privately with Paul Jones over in Wallawalla, is unknown by the public, and they are not interested. There are 115,000,000 people in the United States. There are 114,995,000 who do not know John or Paul as an amateur telegraphist, or that his breed exists. If he does, they should worry. If he does not, they should worry. That is the attitude.

If Bill Bodkins wants to collect pigs' knuckles as a hobby, that is the business of Bill Bodkins. If Phil Deaks is a radio amateur, why worry us about it, they say. Plug in the loud speaker, tune in the jazz, and let's go. What is the price of wheat? And Jonathan apples? And Central Leather? Is it going to rain tomorrow and keep us from going to Shoreville for the skating? Is Madame XSCGHPLKZ singing Ave Maria or Tiddlee Winks tonight? If the ham telegraphist interferes call the radio police.

That is the present consensus of opinion and the general attitude.

The public wants its broadcast entertainment, especially in the evening when Dad comes home from the office, and later when the kids are sitting around the hearth, wide-eyed and expectant, for a fire engine to run past or somethin'. Up in the palsied palaces of the rich, James brings in his mahster's anti-Volstead grape juice about the same time. Well, well, what did New York Central close at? H'm rain tomorrow. Guess I had better delay that conference till Friday. Ha, ha! Cohen on the broadcast. That was a good one.

Radio brings it.

The pith of the whole matter is this: The majority of the public wants its broadcasting when it wants it. That is in the afternoon and the evening—the evening mostly. That's the dope. Nothing else. The amateur telegraphist is going to fit in where best he can.

That does not say he will be anihilated. The dyed-in-the-wool amateur is going to experiment and crash through the ether in spite of Hades and high water, if he has to sit up until the eggs are in the boiler and the toast browning on the toaster. That is if he is of the old school.

If he is of the new he is going to the trundle bed at 11:00 P. M. when the broadcasts stop. No night-owl ether work for him.

The oldtimer will stop experimenting and agonizing the ether when they build a bridge across from Cape Race to Gibralter, but it's going to be after the broadcasts are over when he opens up the old stone crusher. The radio business has changed, is changing and will continue to change.

Also, the dog-fight modulated broadcaster will either close down or repine in ostracism or jail. The bunco dealer will count up the bills, have a fire sale, and start a shoeshine stand. The radio junk manufacturer will find it easier money in the old rubber boot business in central Nyassa.

The old heads are sorry and their sympathy is profuse in its outpourings, but broadcasting has had a public demand made for it. The demand is enormous.

We are sorry, all of us, but broadcasted matter sways the public. The latter likes to be swayed, and they are enjoying it. They want it and will have it. Seelah.

Damping: Its Meaning, Causes and Effects in Radio

By LOUIS FRANK

THERE are certain subjects which are of basic importance in the consideration of any radio topic or problem, and these subjects should therefore be thoroughly understood by the amateur at the start of his radio career. In last month's

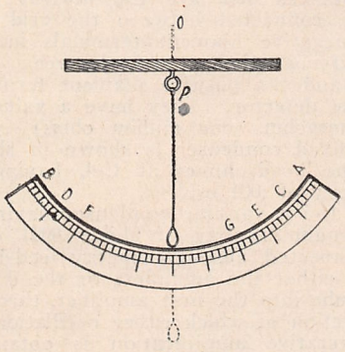


Fig. 1

An Oscillating Pendulum Illustrating the Subject of Damping.

issue of the RADIO NEWS (Jan., 1923) one of these basic subjects—COUPLING—was taken up in its various aspects and its different practical applications were considered. This month another basic topic will be discussed, namely DAMPING.

A simple example drawn from popular everyday mechanics will show at once both the significance and importance to radio of this subject of damping. Suppose we have a pendulum attached to some point of support as in Fig. 1, and suppose that the pendulum is swinging. The distance of the bob from the center line OO to the farthest outside point of any swing, as OA, is called the *amplitude* of the swing. Suppose now we arrange a scale over which the pendulum bob swings, so that we can study the motion of the pendulum more easily. Suppose at the start of the swing that the pendulum swings to point A on the scale, then its initial amplitude will be OA. The pendulum now begins to move back towards C and when it reaches O its energy of motion carries it on towards point B, on the other side of the starting line OO. But due to the fact that the motion of the pendulum meets with numerous resistances, such as the friction at the point of support P, air resistance, etc., the pendulum bob will move a distance OB which is slightly less than the initial distance OA. When the bob reaches its second position OB, it comes back again on its return path towards O and from there it continues on towards A. This time the bob moves only a distance OC which is less than the distance OB for the same reason, namely, loss of energy due to resistance to the motion of the pendulum. Thus the bob keeps swinging to and from the axis OO, but each time the amplitude steadily decreases due to the above mentioned resistances, until the pendulum comes to a stop, when the amplitude is zero.

A visual comprehension of what occurs may be had as follows: Suppose we draw a line OO as in Fig. 2, which line we will call the axis. At right angles to this another line is drawn along which we will scale off distances OA, OB, OC, etc., on either side of the axis, equal to the various amplitudes of the swings of the pendulum. Above the axis OO indicates that the swing of the pendulum takes place to the right of the point of support, and below indicates that the swing is to the left. If the position of the pendulum bob is thus plotted graphically for each moment we will have a curve such as shown in Fig. 2, which shows that the amplitude of the pendulum oscillations gradually decreases to zero.

This reduction of the amplitude of swing is said to be caused by the *"damping"* of the pendulum and the swings or oscillations are said to be *"damped."* This *damping* was seen to be due to the various resistances to the motion of the pendulum. The greater these resistances are the greater will be the damping of the swings. Thus suppose that to the pendulum bob there is attached a sheet of cardboard or other material having a large surface area. There will then be a greater air resistance to the motion of the pendulum since the entire pendulum has to move through a great volume of air. If the amplitudes of the swings are now plotted in accordance with the method of Figs. 1 and 2, we will have a motion of the pendulum as represented in Fig. 3, where the decreases in amplitude are much greater and the oscillations cease in a very short time. Such a pendulum is said to have a "high damping" or a "high decrement," while a pendulum which swings as in Fig. 2, in which the decrease in amplitude is small from oscillation to oscillation and in which it takes a long time for the amplitude to decrease to zero, is said to have a "low damping or decrement." If there were no resistance interposed to the motion of the pendulum, or in other words if there were no "damping" or "decrement," there would be no falling off in amplitude at all.

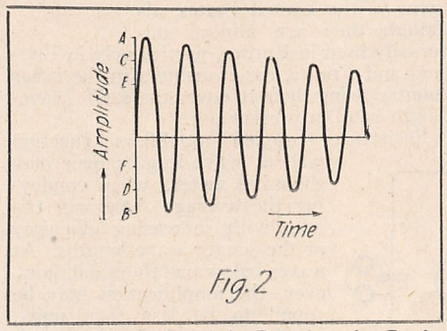


Fig. 2

A Visual Illustration of the Damping of a Pendulum Movement Due to Resistance

The application to radio will be immediately evident. In radio we deal with electrical circuits containing capacity, inductance and resistance, and in these circuits there flow oscillating radio frequency currents. Just as in the case of the pendulum the resistance in the circuit obstructs the flow of the electric current and dissipates a portion of the energy. As a result the successive amplitudes of the oscillating current grow smaller and smaller and finally decrease to zero, due to the "damping" or "decrement" of the electric circuit. That is, this decrease in amplitude will take place if the circuit is left to itself, unless the current supply is continuously replenished by some outside source.

Thus we see that DAMPING is that property of an electric circuit which results in a decay of energy in that circuit. If the decay of energy is very rapid, or would be very rapid if allowed to decay, we say that the circuit has HIGH DAMPING or HIGH DECREMENT. If the decay of energy is slow the circuit has LOW DAMPING or DECREMENT. Circuits having low and high damping would then have current amplitude curves as shown in Figs. 2 and 3 respectively—when the currents are actually damped.

This last clause should be carefully pondered over in order to fully understand the signficance of the *idea of damping.* There are many cases in radio in which the current amplitude in a radio circuit remains constant—does not decay. This does not necessarily mean that the circuit has no damping. The circuit may have damping and does dissipate energy, but this dissipation of energy—which would otherwise cause a decay in the current amplitude—is replenished and compensated for by an outside source of energy which maintains the current amplitude constant. Thus, to come back to our analogy of the pendulum, if an outside source of mechanical energy, say a person, gave the pendulum a push at the proper time always, its amplitude of swing would not diminish but would remain constant, in spite of the air resistance and the dissipation of energy due to it. The external source of energy, namely, the person, is always making up for this loss of energy by giving the pendulum a push. In other words the dissipation of energy still is there, and the pendulum still has its inherent damping. The more the resistance to its motion, the greater is the damping of the pendulum, and the more the person has to push the pendulum to make up for it. The damping of the pendulum asserts itself in a decrease of the swing only when left to itself after the first push. Similarly in radio, the damping of a circuit produces a decay in the current amplitude only when the circuit is left to itself after it has been given an impulse. But even if the current amplitude does not decay due to the help of an external source of electrical power, the damping of the circuit is present, and it exerts its various effects on the operation of the circuit as will be explained later. In other words the decay of energy due to damping takes place only when the circuit is left to itself after an electrical impulse has been imparted to it, *but the damping is present regardless of whether this decay takes place or not.*

While *damping* is the property of the circuit resulting in a decay of energy, *decrement* is the quantitative measure of this decay and tells just how much the current amplitude decreases from cycle to cycle for any given circuit.

What are the factors on which the damping, and hence decrement depend? In the first place from our explanation of the meaning of damping given above it will be clear that it depends upon the resistance of the circuit, since resistance always dissipates energy. The damping or decrement of a circuit is directly proportional to the

(*Continued on page* 1573)

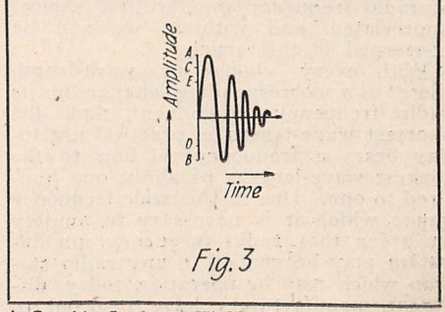


Fig. 3

A Graphic Study of Highly Damped Oscillations with a Corresponding High Decrement

Radio Frequency Amplification

By JOHN M. AVERY

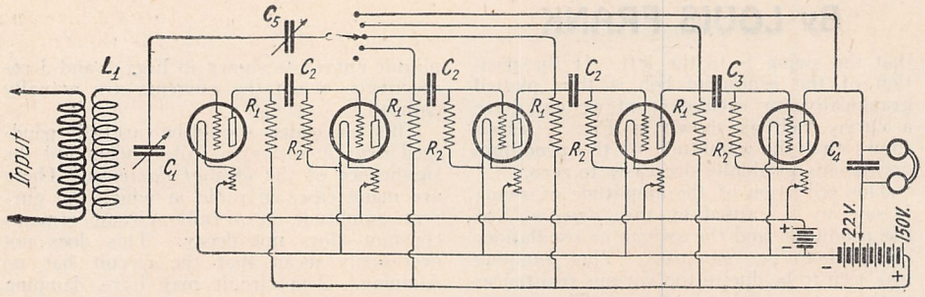


Fig.1

A Four Stage Resistance Coupled Radio Frequency Amplifier. Successive Stages are Controlled by a Switch.

SINCE a triode will repeat in its plate circuits, with increased amplitude, currents of any frequency impressed on its grid, it may be used as an amplifier of either radio or audio frequencies, in conjunction with some detecting device, preferably another triode. Briefly, if amplification is desired at radio frequencies, the radio frequency amplifying triode is connected in such a manner as to boost the incoming signal before it reaches the detecting device, while for audio frequency amplification it is connected in such a manner that it receives the incoming signal after detection.

Furthermore, the sensitivity of a triode as a detector varies very nearly as the square of the voltage applied to its grid. It will be seen then, that if an extremely sensitive receiver is desired for long distance reception, radio frequency amplification may be preferable while if very strong signals are desired from those already detectable, audio frequency amplification is the preferable method.

The general trend of present-day radio seems to be toward decreased power at the transmitting station and increased sensitivity at the receiver, and at the same time, toward the spanning of great distances with a minimum of power. It is in these instances that the effectiveness of radio frequency amplification is most appreciated, and with it, we will be concerned in this article.

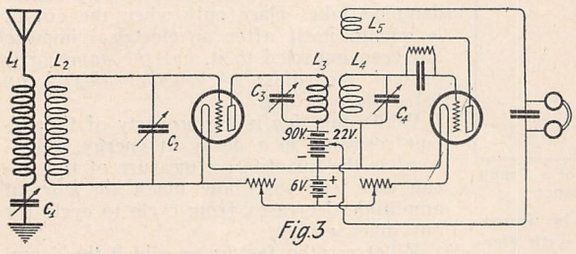


Fig.3

Cascade Amplification Employing Loosely Coupled Inductances. Variable Condensers are Provided for Tuning the Respective Circuits.

With every change in wave-length there is a corresponding change in its radio frequency component, and the shortest wave-length in practical use today bears a frequency relation to the longest wave-lengths of about one hundred to one. Due to this wide frequency range which it is necessary to amplify in order that radio frequency amplification may be applied to any radio station which may be operating today, different manufacturers have resorted to different expedients as inter-valve couplings. In general these may be divided into the following classes:

1. Resistance coupling.
2. Choke coil coupling.
3. Tuned impedance coupling.
4. Air-core transformer coupling.
   a. Aperiodic.
   b. Tuned.
5. Iron-core transformer coupling.
   a. Aperiodic.
   b. Tuned.

These divisions are merely arbitrary, many of the inter-valve couplings at present utilized being a combination of one or more of these divisions, as will be noted later.

With the exception of utilization in the Armstrong super-heterodyne receiver, resistance couplings do not seem to be in favor in the United States, although they are almost universally used in Europe, particularly in England and France, experimenters in the latter country using them to cover the entire wave-length band in present use.

Resistance coupled amplifiers function well at wave-lengths over one-thousand meters when employing the average American triode, with increasing efficiency at the longer wave-lengths. At waves below one thousand, however, the amplification may be found to be less than unity, i. e., a decreased signal strength will result. It has been shown that this is due to the high internal capacitance of our American triode, which, though small in itself, is markedly detrimental in this type of amplifier. French experimenters have constructed special valves for use with this circuit in which the grid and plate leads enter the tube through the side walls, rather than through the base, decreasing this capacity value to negligibility.

The circuit diagram shown in Fig. 1, represents the proper connections for a resistance coupled amplifier of four stages, and a triode detector. This is probably the easiest type of amplifier to construct, and should be of especial interest to those attempting to receive foreign stations working on long wave-lengths (2,500 to 20,000 meters). Referring to the diagram, L-1 is the normal secondary of the receiving transformer, with its tuning condenser, C-1. The grid condensers of the amplifier tubes, C-2, have a capacity of .0005 mfd., and the detector tube, C-3, a capacity of .0001 mfd. The coupling resistances, R-1, the main feature of this circuit, are non-inductive resistances of 50,000 ohms each. These may be lavite units or any other type having a constant value. Resistances R-2 are the normal grid leaks, connected between the grid and the negative filament terminals in the amplifying triodes, and between the grid and the positive filament terminal in the detector. They have a value of one megohm (one million ohms) each

A fixed condenser is shown in shunt to the head-phones at C-4, having a capacity of .001 mfd.

At C-5 a variable condenser having a maximum capacity of about .0001 mfd. is connected, attaining energy feed-back from either the amplifiers or the detector tube into the first amplifier, through the action of which either oscillation or regenerative amplification is obtained. A five-point switch is shown for selecting the amplifier tube through which the feed-back is desired, and having an "out" position. In the construction of this switch space the contacts well and widely separate the leads from it, or undesirable oscillation may occur in the amplifier. Use nothing but mica or air dielectric fixed condensers in the various grid circuits. The use of paper condensers will introduce boiling and frying noises.

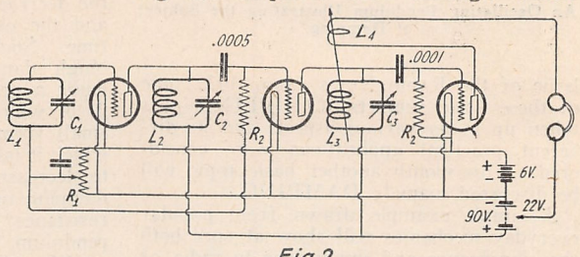


Fig.2

Circuit of a Tuned Impedance Amplifier, Using Fixed Inductance and Variable Capacities.

The amplifier just described may be successfully combined in a super-heterodyne receiver without changing any of the values indicated above.

Small choke coils may be substituted for the 50,000-ohm resistances in the amplifier just described, attaining practically equal results. The author utilized the bobbins of several sets of 2,200-ohm Federal head receivers for the purpose, dismantled the receivers and removed the bobbins with their soft iron cores from the aluminum cases and the magnets. Two bobbins (the complete electro-magnet system of a single receiver) were connected in series and in the amplifier plate circuits, and mica

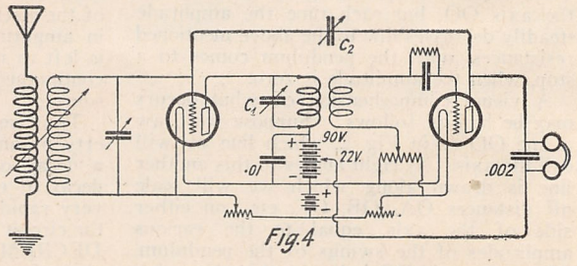


Fig.4

A Circuit Employing the Usual Inter-Valve Amplifying Transformers. Additional Amplification is Obtained by Feeding Back the Resultant Energy Through Condenser C2.

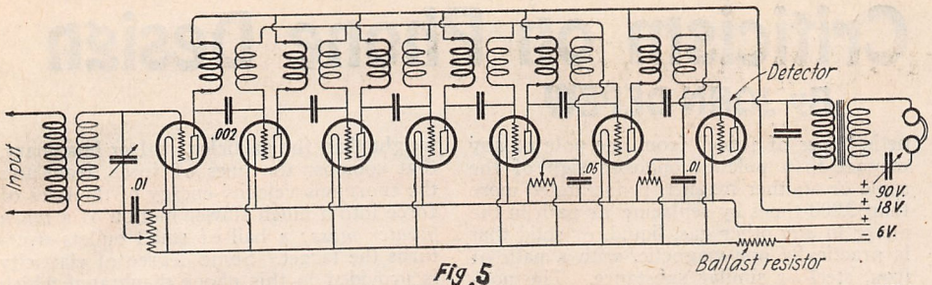


Fig. 5

A Radio Frequency Amplifier Circuit Using Semi-operiodic Coupling Transformers, Doing Away With the Necessity of Variable Condensers for Tuning.

condensers of .002 mfd. substituted for the normal grid condensers described for the resistance-coupled amplifier. With the circuit thus connected, good amplification was secured at a wave-length of 1,500 meters, and both regenerative amplification and self-oscillation were attained down to 500 meters wave-length, through proper adjustment of condenser C-5. The only advantage apparent to the writer, however, was economy of plate voltage which while using VT-1 tubes in both cases, was only 70 to 90 volts with the choke coils as compared to 150 volts with the resistances.

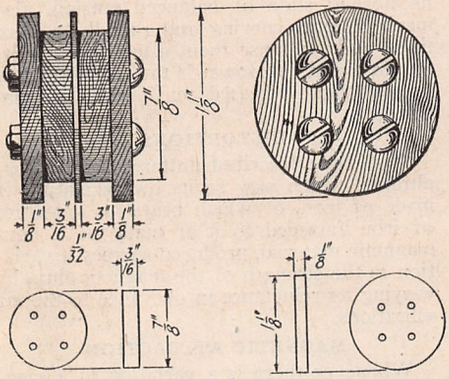
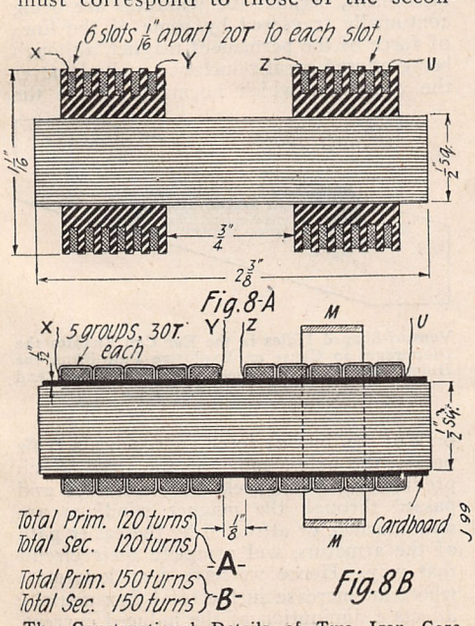


Fig. 6

Core Details for a Coupling Transformer of the Non-Magnetic Core, Aperiodic Type.

Particularly efficient as intervalve couplings are tuned impedance circuits, properly connected. Referring to the circuit diagram, Fig. 2, L-1, C-1, is the normal secondary tuning circuit. To this is directly connected an amplifying triode, having in its plate circuit a tuned circuit L-2, C-2, the electrical values of which must correspond to those of the secondary circuit. L-1, C-2. The direct current from the supplementary plate battery B-1 finds a path of low resistance through the inductance of coil L-2, but the combination of the coil and condenser. when tuned to any particular frequency, form a practically infinite impedance to that frequency, with the result that the radio frequency energy is impressed on the grid of the next triode in the cascade, through its grid condenser. Due to the fact that only frequencies approximating that to which the impedance circuit is tuned are amplified, great selectivity will be found to be a feature of this circuit. As a matter of fact, the tuning becomes so sharp that more than two such stages are difficult of adjustment. For additional regenerative amplification or the reception of undamped waves, a tickler coil may be included in the plate circuit of the detector triode as at L-4, coupled magnetically to either L-3 or to L-1. Grid leak resistances R-2 may have values of one megohm, and the stabilizer R-1 about 200 ohms. The purpose of the stabilizer is to prevent undesirable oscillations from being set up in the amplifying circuits when the impedance coupling circuits are in resonance. An enterprising firm has recently placed similar combinations of an inductance with a variable condenser for use in this circuit on the market, having a wave range of from 200 to 600 meters. Should the experimenter desire to construct such an amplifier, it is recommended that honeycombs of the "duo-lateral" type be used for the inductances. Since the wave-length range of this device is dependent entirely upon the frequency to which the impedance circuits can be tuned, the following table of duo-lateral coils has been prepared as being suitable as impedances when shunted by a variable condenser of .001 mfd:



The Constructional Details of Two Iron Core Transformers are Shown Above. The Copper Ring M in Fig. 8B Se ves to Broaden the Effective Wave-length of the Transformer.

TABLE I

Duo-lateral Coil Values for Tuned Impedance Amplifier

Wave-Length Range	L-1, L-2, L-3	L-4
150 — 350	DL 25	DL 35
300 — 700	DL 50 or 75	DL 50
450 — 1,000	DL 100	DL 75
800 — 2,000	DL 150	DL 100
1,750 — 4,000	DL 250	DL 150
4,000 — 8,500	DL 500	DL 250
6,000 — 12 500	DL 1,000	DL 500
12,000 — 20,000	DL 1,500	DL 750

A variation from the intervalve coupling, just described, lies in the use of loosely coupled tuned circuits between the tubes, in which case the energy is transferred from the plate circuit of the preceding triode into the grid circuit of the second by induction. Ordinary receiving transformers (improperly, "loose-couplers"), having both the primary and secondary windings shunted by variable condensers for wave-length adjustment purposes may be used. The circuit diagram is represented in Fig. 3. In the diagram, L-1, L-2 are the windings of one receiving transformer tuning the antenna and first triode grid circuits to resonance with the desired station. At L-3, L-4 is a second tuning transformer coupling the amplified energy from the plate circuit of the first amplifier tube into the grid circuit of the detector tube (or another amplifier). A tickler coil L-5, may be coupled to L-4 for further regenerative amplification or for self-heterodyne as a beat receiver. By selecting large values of inductance at both L-2 and L-4 (as compared to their shunt capacitances), a favorable "voltage step-up" action may be attained, and this in conjunction with proper coupling between L-3 and L-4 will result in enormous signal strength from signals formerly entirely inaudible. While more than one or two such amplification stages are undesirable, due to the extremely critical tuning, for such purposes as reception at a predetermined wave-length, for which the entire receiver is calibrated, as in radiophone work or in the working of telegraph schedules between stations, it may be recommended or even preferred. The author recently assembled a receiver, using four such stages, with stabilizers, and obtained some remarkable signal strengths from Pacific Coast stations in New York City.

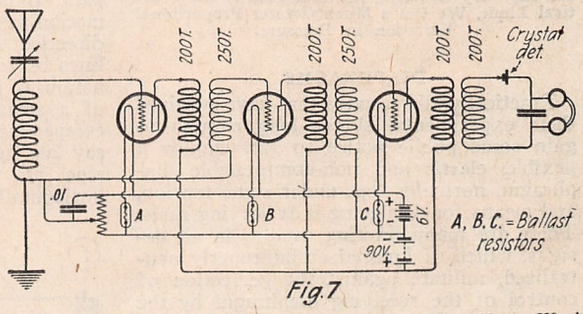


Fig. 7

Aperiodic Type of Transformers Designed for 600 Meter Work Are Used Here. The Number of Turns for Each Winding is Designated.

It appears that two-coil intervalve transformers are now the more popular type among manufacturers, and although they have all been developed from the circuit just described many variations have entered into their construction increasing in some respects their effectiveness. A great many radio frequency amplifying transformers have appeared on the amateur markets on both sides of the Atlantic. and it is noted that the general trend is to design them so as to have fair efficiency over rather limited wave-length range, and being equipped with a plug system so that other wave-length range transformers may be easily substituted in some sort of mounting. American manufacturers equip their transformers with standard four-prong plugs so that they may be plugged into ordinary triode sockets of the types supplied on the American market, while British manufacturers equip theirs with four pins to

(*Continued on page* 1500)

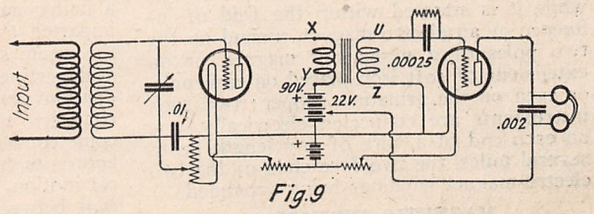


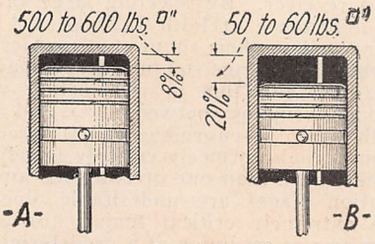
Fig. 9

One Stage of Radio Frequency Amplification Employing the Iron Core Type of Transformer.

Constructive Criticism on Phone Design

By JOHN DEPEW

THERE is a maxim current among radio enthusiasts that "The phones are half the set," so a brief critical survey of some high lights in the development of phone receivers, etc., for the past 60 years, may be worth our while, as it would tend to point out the most likely means for their further improvement.



Comparative Illustration of the Effect of Clearance Between the Top of a Diaphragm and the Inside of the Cap. By Reducing the Clearance to the Practical Limit, We Get a Much Greater Proportional Variation in Pressure.

DIAPHRAGMS

Practically all receivers that have survived their experimental stages long enough to gain some public notice so far, employ a flexible, elastic and non-compressible diaphragm, normally kept under some tension, and means for displacing it at varying rates. There are many limiting factors in all designs, which, if ignored or improperly neutralized, militate against the perfection of control of the receiving diaphragm by the actuating medium.

THE STRING OR LOVERS TELEPHONE

At one time the simplest and one of the best phones was a properly constructed string phone. Two cylinders of almost any material, each about 4" in diameter, by 4" deep, with a sheep-skin or preferably calf-skin membrane tightly stretched over one end of each cylinder and a thin strong cord, or better still thin bare copper or copper wire stretched with moderate tension between two small buttons, each placed within the center of the membranes within the cylinders directly over a small hole through which the string or wire passes, will transmit music and speech, in either direction.

The tone is remarkably clear and pure, with a good proportion of volume, and for distances up to about 1,200' conversations can be comfortably maintained indefinitely, with either or both parties situated within 3' or 4' of the instruments. The string or wire is freely suspended at intervals by loops of cord or wire at least 3' long. For greater distances the inertio of the cord obstructs the transmission of weaker vibrations, the so called harmonies, and greatly diminishes the characteristic overtones of the sounds, rendering them distorted, weakened unequally, and confused.

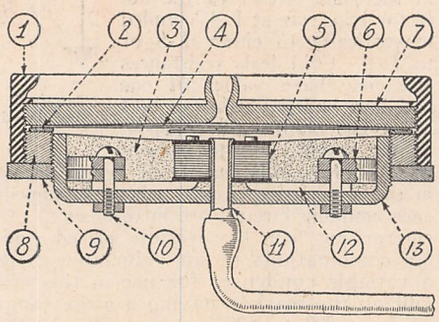
INDUCTION PHONES

For greater distances, or for locations where constant tension on a freely suspended line is not feasible, induction phones can be used with moderate success. They operate as follows: An iron diaphragm or armature is made to vibrate by the sound waves, while it is situated within the field of influence of an electro-magnet, wound on the two poles of a permanent magnet, or on extensions of soft iron placed on each pole, or even on the armature proper; two such instruments are connected electrically, one on each end of a wire of any length up to several miles, the two free ends of the two electro-magnet windings being grounded.

MAGNETIC INDUCTION

A magnetic flux, that is, the flow of magnetic "lines of force" from one pole of any magnet to a pole of opposite sign of the same or another magnet, is facilitated more than 2,000 times by replacing its path in the air or in any other gas, liquid, or solid that is practically non-magnetic, with a path of iron, steel or similar substance. The non-magnetic substance offers a "reluctance," which term is analogous to "resistance" in electric circuits. This cuts down the force over 2,000 to one; therefore, a break equal to the thickness of a piece of newspaper separating an iron or steel magnetic circuit cuts down its force as much as would 4" of steel of the same cross section, added to the length of the circuit.

All magnetic circuits always endeavor to shorten the path of their "lines of force" whenever possible, and when a piece of iron offers a magnetic path 2,000 times shorter than the space it fills, lines from all directions in the vicinity "leap" toward the iron path, thus imparting sensible mechanical motion to the armature or iron path, in such direction, as to offer a chance for the most lines of force to become so shortened. The action is in many respects similar to that of a steam injector; steam is allowed to escape from a boiler under any pressure, say 200 lbs. to the square inch, through a pipe into a funnel-shaped chamber placed horizontally and filled with cold water at



A Phone Incorporating Improvements Set Forth by Mr. Depew. They are as Follows: 1, Phone Shell; 2, Flat Ring Welded to Diaphragm; 3, Paraffin Filling to Level of Pole Pieces; 4, Diaphragm With an Extra Lamination Fastened at Center, With Tissue Paper Between of ½" Lesser Diameter; 5, Coils; 6, Two Permanent Magnets; 7, White Ear Cap; 8, Threaded Adjustment Ring; 9, Knurled Lock Ring; 10, Screws Fastening Magnets; 11, Ear Tube Outlet; 12, Pole Extensions; 13, Case.

atmospheric pressure. As the steam, rushing out at an enormous velocity of some 15 or 20 miles *per second* at the nozzle, strikes the cold water, it condenses, *becoming diminished in volume more than* 750 *times, very quickly.* As there is nothing lost in this world, this energy of velocity which the steam possessed prior to its shrinkage is imparted, along with its temperature, to the cold water. If we open a valve into the water (or even the steam) section of this or any other boiler under similar pressure, this newly heated water will *rush into the boiler,* overcoming its pressure of 200 lbs. to the square inch. Although starting under atmospheric pressure only, the additional great pressure necessary to enable it to enter a boiler under 200 lbs. per square inch, is imparted to it by the sudden *shortening* of the steam stream.

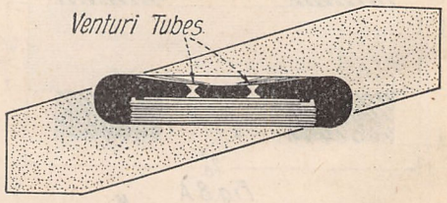
Reverting to our consideration of the induction phone, we see that by offering a chance to the lines of force to suddenly become condensed (shortened), we acquire its approximate dynamic equivalent in mechanical motion, work being done by the *attraction* between the magnetic circuit and the iron path. In other words, the condensing medium, being of much greater mass or weight than the particles, real or imaginary, that compose the lines of force, translates the enormous velocity-energy of the lines of force into a much slower motion of a *much greater mass;* a hail of small bullets overturns the target. Some degree of elasticity is provided in this phone diaphragm which ordinarily just balances the pull between the permanent magnet and the armature, preventing it from approaching too close to the pole pieces, but when air vibrations impringe on the diaphragm, it becomes displaced momentarily, approaching and receding microscopic distances in successive moments. thus continually condensing a *varying number* of lines of force. Since these lines radiate in all directions from the pole pieces, like a spray, a minute approach of the armature towards the pole pieces enables it to intercept, in addition to the direct lines which it keeps condensing while in its normal state of balanced tension, also many oblique, curving and radially pointed lines, and condense them also, thus acquiring an added pull towards the poles, checked by the thus increased tension of the diaphragm.

DISTORTIONS

The above described fluttering of the diaphragm, which may be its own armature if made of iron, or which bears an armature of iron fastened to it if made of a non-magnetic material, produced thereby a variation in the strength of the magnetic flux, by varying its reluctance in obeyance to the air vibrations.

MAGNETIC ATTRACTION

Whenever there is a variation in a magnetic field, that is, a change in the flux, the strength of the magnetic flow of lines, and there happens to be an electrical conductor within its sphere of sensible influence, a measurable current of electricity is induced thereby to flow through the conductor. If it is in a closed, round trip circuit, current would also flow into the conductor if the circuit is open, but then it would merely flow until it filled the capacity of the conducting system and its insulation, flowing into the conductor when the field increases, and surging back again when the field decreases. Varying the flux of the permanent magnet, therefore, induces a varying current in the windings of the electro-magnet in the speaker's instrument, because the windings are being continually traversed by some of the lines of force of the permanent magnet, although being offered great reluctance, and whenever the armature, which normally carries the



Venturi-Shaped Holes in the Ear Cap Enables the Diaphragm to Cause an Explosive Puff From the Holes Thereby Increasing Sensitiveness and Audibility.

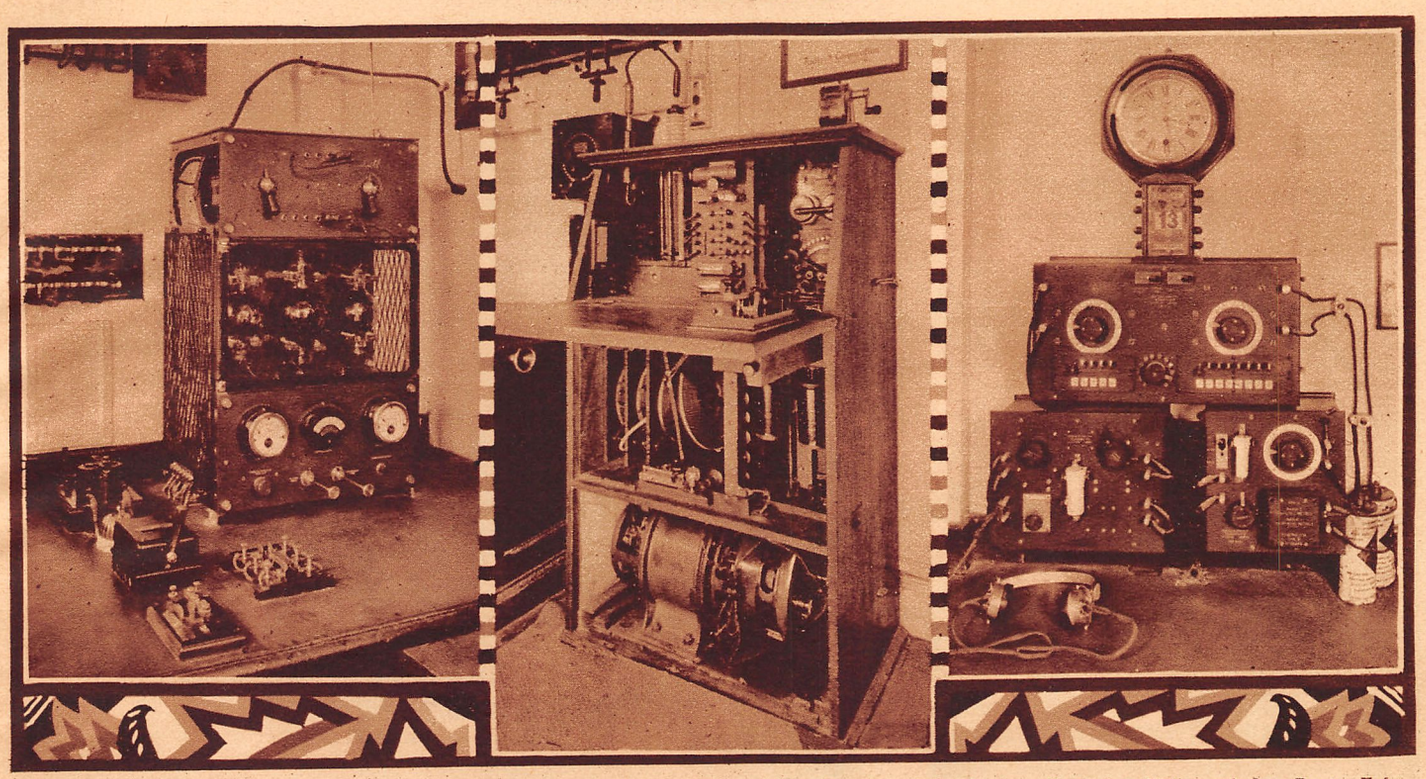
bulk of the lines of force approaches a trifle nearer the poles, some of the lines which previously curved back on themselves and passed through the magnet windings are now touched, or attracted by the easier path of the armature and complete their circuit that way. Hence we have a curious state where an increase in the total flux actually affects a diminution of the induced current.

It can be readily seen that a phone of this type, actuating the distant, listening phone

(*Continued on page* 1583)

Q S T de M S U

By C. A. REBERGER

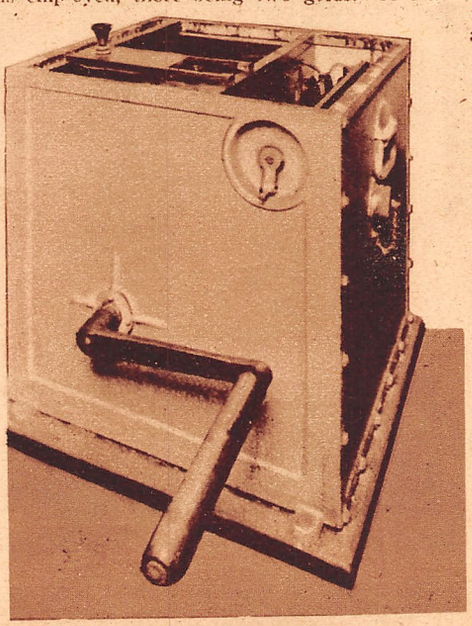


Left—500 Watt C.W. Transmitter of the Aquitania Which Has Made Some Remarkable Records. This Employs Rectifying Tubes and One Power Tube. The power is derived from a motor generator. Center—The Five K.W. Spark Transmitter. The Rotary Spark Gap is Mounted on the Same Shaft as the Motor Generator. Right—The Receiving Units, the Left-hand of Which Holds the Heterodyne Set Used for Receiving Continuous Wave Signals. It Tunes from 200 to 20,000 Meters. The Cabinet on the Right is the Detector Unit for the Main Tuner Resting on Top, Which is Used for the Reception of Spark Signals.

ONCE in a blue moon, a dream comes true. For years C. V. Maudsley, A. H. Forman and A. F. Porter dreamed of being radio operators aboard some great ocean liner and at last their delusions have come true, for they are, at the present writing, chief, second and third operators respectively aboard the 45,000 ton Cunard liner Aquitania, better known to wireless men as MSU. But they are not the only ones who have such dreams for there are still hundreds of other commercial operators and many amateur radio enthusiasts who are looking forward to the day when they will operate the equipment aboard some giant vessel like the Aquitania. Truly, it is the ambition of many but the realization of only a few, for there are not many ships like MSU. The high, clear, musical spark of the Aquitania is one that attracts immediate attention. It is well known on the North Atlantic and the hearts of many beat fast when they hear her working for at once they have visions of a great ship, with a wonderful radio room. When at sea she is a city of some 3,000 souls—a city of the sea.

For generations the ships of this line have been built with two main features predominating in the minds of the designers. These two elements are safety and comfort. The question of safety has been given the greater consideration of the two and under this heading comes her splendid radio equipment. She carries a spark transmitter more powerful than any other merchantman has, besides a continuous wave transmitter and an emergency set. There is even a large lifeboat equipped with a complete radio installation. She is also equipped with the latest submarine signalling device for detecting any possible approach to danger while at sea. Besides this the vessel is completely wired with an automatic electric fire alarm system and even the deepest cargo holds are connected with the bridge by a combined system of indicator and extinguisher.

The receiving installation aboard the Aquitania consists of two independent receiving units, either of which may be used by simply throwing a switch which is mounted in a convenient manner. One set is known as a piano tuner. It has been termed such by the English operators because of the fact that tuning is accomplished by a number of keys, arranged like those found on a modern piano. It is nothing more than a number of inductances connected in such a manner that wire may be added or subtracted by pressing down either or all of the keys. For detector, a four element tube is employed, there being two grids. A six volt storage battery lights the filament while plate voltage is furnished by a 24 volt battery. The other tuner is known as a Heterodyne receiver and goes anywhere from 200 to 20,000 meters. This is used mainly for copying C.W. Here a bulb is also used for detector. The phones used are of English manufacture, wound to a resistance of 120 ohms. A special design transformer is incorporated in the receiving set which really brings the resistance of the phones up to over 2,000 ohms. If this transformer had not been built, the English Marconi Company would have had to discard several thousand pairs of these low resistance receivers, most of which were made previous to the appearance of the crystal or audion receivers. Wound to a resistance of 120 ohms they worked well with the old magnetic detector type of receiving set.



The Complete Lifeboat Transmitter and Receiver. The Handle Protuding from the Side is Used in Conjunction With the Hand-Operated Generator Which Supplies the Necessary Power.

The main spark transmitter is one of 5-kilowatt power rating, the rotory gap being mounted on the motor generator shaft, similar to the idea followed on the American Marconi Company's 2-K. W. panel type transmitter. Though it is rated at the above power, the set can easily be forced up to 7 K. W. and one can readily realize what the radiation would be, and what work could be accomplished. In a separate room, just off the main operating quarters is located the big 5-kilowatt motor generator, condensers and aerial tuning inductances. By means of a plug and jack arrangement, transmission can be carried on on 300, 450, 600 and 800 meters. It is expected that there will soon be arrangements made for an 1800-meter wave-length. In this same room are also located the antenna switch and the four pole switch which is employed for throwing either the spark or C. W. transmitter in the circuit. Switches, rheostats, etc., for controlling the motor generator are mounted conventiently on the operating table. When transmitting, the current is broken through a heavily constructed relay.

(*Continued on page* 1546)

Radio Pictorial

Above: The Recently Completed Radio Station at Mount Corcovado, Overlooking the City of Rio De Janeiro, Enjoys the Distinction of Being the Highest Radio Station in the World. This is About 2,100 Feet Above the City Level. Workmen Experienced Many Thrills While Erecting the Aerials.

(C) International Newsreel

Above: Dr. Ernest M. Stires, Rector of St. Thomas' Church, New York, Delivering a Sermon. The Ten Microphones Scattered Throughout the Church Relay the Entire Service to WJZ at Newark, New Jersey, Where it is Broadcasted. Note the Microphones on the Desk.

(C) Kadel & Herbert

Above: Listening in at Selfridges for the First Radio Call From America, Coming From Sir Thomas Lipton Through Bamberger's Station (WOR) at Newark, New Jersey.

Center: Major General James G. Harbold, Delivering the Story of the Army-Navy Game Into the Radiophone Transmitter at Franklin Field, Philadelphia, Pa.

(C) Underwood & Underwood

Radio Saved His Business

THE business acumen of Angus McCallum, 10 years old, sole proprietor of a soda pop stand the past summer, in Kansas City, Mo., has solved a problem for him. To begin with, business was not so good for Angus. Pedestrians sauntered by his stand wholly ignoring the gorgeous array of pop bottles, and truck drivers raced by with an excuse-my-dust attitude which caused much concern. Rivals waxed prosperous, while Angus sadly lacked patronage. That is, until all the ingenuity of 10 years was brought into play. Then Angus hung up a sign bearing this inscription: Hear the Radio Ball Scores—WDAF. It happens that Angus is a radio enthusiast of the first order and is the proud possessor of a fully equipped receiving set. After this sign was put up, workmen made his stand their

Hot Stuff from the Radio and Cold Soda Pop to Cool Them Off is the Philosophy of This Young Man Who Built Up a Thriving Business by Giving the Baseball Scores by Radio

rendezvous, and, while listening to the latest baseball returns, quaffed innumerable bottles of pop. When there were concerts at night, chairs were brought out to accommodate regular customers, who were served by Angus and Mary, his sister, who is all a pal could possibly be. An electric light was placed in a nearby tree to attract bugs and mosquitoes, for only *radio* "bugs" were permitted in or near the stand. Young Mr. McCallum enjoyed an almost undisputed monopoly, all serious competition having ceased. "Too much radio," is the unanimous verdict of his former competitors in soda pop. And Angus—well, Angus's face after that was a triumph of smiles as he advised every one to "do it with radio." "All my profit is going to dad's bank," he proudly declares.

Which Goes To Prove—

MISS Ruby Wrightson, of Mobile, Ala., just 18 years of age, has been following up radio as her favorite study for some time past which goes to prove that we of the whiskers are not the whole "shooting match."

Last May she took an examination for a first-class amateur license, passing with a percentage of 91. From that time, she has been constructing her own sets. One is a short wave receiver and the one you see in the picture is a multi-range regenerative receiver which she copied from page 860 of the November issue of RADIO NEWS. This

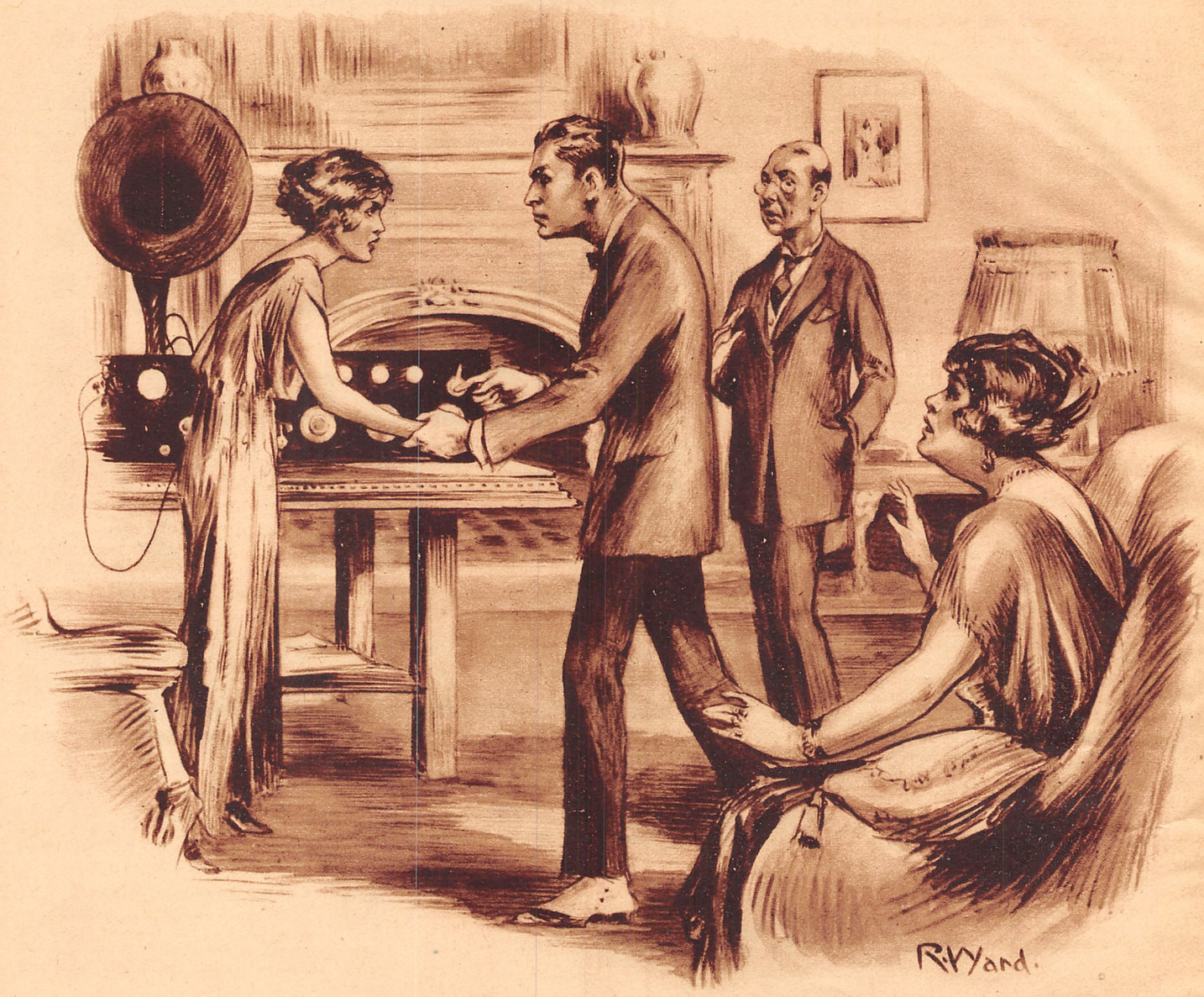
Miss Ruby Wrightson Seated Before Her Radio Set. The Entire Outfit Was Constructed by Herself. She Is the Proud Possessor of a First Grade Amateur License

multi-range receiver is entirely her own work. The bank-wound coil was made by herself as well as the panel and carpentry work. This receiver has given very fine results; Miss Ruby has many friends and every night they enjoy hearing good music and speeches from various broadcasting stations all over the states, the longest distance up to the present time has been Los Angeles, California.

This set was constructed at a total cost of $13.85. The fine results obtained prove the ability of the constructor and as well, may we say, her economy (an important factor). How about it, OM?

Mr. and Mrs. Brownlee Hold Hands

By ELLIS PARKER BUTLER



Sophia, take your hand off that dial! Do you hear me? Once! Twice! For the third and last time—

ONE evening when Mr. Murchison had seated himself in the smoking car, en route from New York to his home in Westcote, his radio-enthusiastic neighbor Brownlee came and sat beside him.

"Hello, Murchison," Mr. Brownlee said; "How is your radio working these days?"

"Brownlee," said Murchison, frowning, "I wish you would not talk about radio to me. It annoys me, Brownlee. But if you must know, Brownlee, my radio is not working at all these days. You know very well, Brownlee, that the last time you were in my house you tried some silly stunt and wired Mrs. Bimberry's ankle to the radiator, and my wife has not spoken to me since. I have not been near my radio, Brownlee, since that night. In my opinion, Brownlee, radio has caused enough trouble in my family."

Mr. Brownlee, who remembered the night of Mr. Murchison's radio party quite well, blushed, but he was a genuinely enthusiastic radio lover and after a moment he said:

"If you will pardon me for saying so, Murchison, that trouble was not the fault of the radio. Radio never causes trouble. Radio brings peace and happiness into the home."

"You mean," said Mr. Murchison, "that my wife allowed herself to—ah—to become irritated."

"That is exactly what I do mean," said Brownlee frankly. "And I say so because nothing of that sort ever happens in my home. Night after night my wife and I sit before our loud-speaker, often holding hands as we did when we were young lovers, and listen to the soothing strains of sweet music as they come to us through the air. Even if I have been irritated by business cares and my wife has come home a little cross from some quarrel at her club, the music soothes and delights us and we are more loving and amiable than ever before. I do hate to think that you have given up radio, Murchison! I wish you could see how it warms and softens the hearts of my dear Sophia and myself—how we sit there evening after evening——"

He stopped short and slapped Mr. Murchison on the knee.

"Say!" he exclaimed enthusiastically; "You've got to come over this very evening! It is going to be a great evening! Do you know what WPX is broadcasting tonight? Why, man, WPX is broadcasting the Benk-Coogan prize fight right from the ringside!"

"You don't say!" exclaimed Mr. Murchison. "By George, that ought to be great! What time——"

The result of this conversation was that shortly after dinner Mr. Murchison coughed gently and told his wife he believed he would run over to Brownlee's for an hour or so if she did not mind.

"I would far rather you went there than that you brought him here," said Mrs. Murchison coldly, and Mr. Murchison put on his coat and hat and went over to Brownlee's. When the maid ushered him into the library, where Brownlee's radio was installed, no one was there.

"Mr. Brownlee said, sir," the maid told him, "that I should tell you he had just gone out for some cigars, but he will be back soon. Mrs. Brownlee is not home; she went out auto-riding with Mrs. Bimberry and stopped there for dinner."

Brownlee returned almost immediately. He handed Mr. Murchison one of the cigars and told him to light up, and lit a cigar himself.

"I'm sorry my wife is not home," Murchison," he said. "This prize fight is going to be great, but what I really wanted was for

(*Continued on page* 1557)

Who's Who in Radio

W. C. WHITE

W C. WHITE, of the Research Laboratory of the General Electric Co., is one of the prominent men in the field of radio investigation and invention, and has to his credit a number of important developments. Since he joined the staff of the laboratory, about ten years ago, he has contributed extensively to radio and vacuum tube progress and is among the acknowledged authorities on the subject as well as an inventor of distinction.

Born in Brooklyn, in 1890, Mr. White received his preparatory education in the Englewood, N. J., High School, from which he was graduated in 1908. He spent the following summer in the Research Laboratory of Schenectady, and in the fall began the course in electrical engineering at Columbia University, from which he was graduated in 1912. He then became a member of the staff of the laboratory, as an assistant to Dr. Irving Langmuir, and is still so employed.

His interest in radio began at an early age. When only 13, he constructed a radio transmitting and receiving equipment at Englewood, and the following year he built a form of portable receiver and used it in Florida to hear the naval station at Pensacola. While a senior in high school he and other boys of the town built radio sets for communicating among themselves.

W. C. WHITE

For the first few months after joining the General Electric Co., he devoted his attention to mercury arc problems, and then took up vacuum tube work. Some years later he conducted important experimental work on the generation of very short waves and very low frequencies by means of vacuum tubes, and in 1919 took an active part in high power radio telephone tests with the U. S. S. *George Washington*. For the past few years he has given particular study to high power vacuum tubes, and he has taken out a considerable number of patents on vacuum tubes.

Numerous articles by Mr. White have appeared in RADIO NEWS from time to time. One of special interest entitled "Some operating Characteristics of Electron Tubes" was published in the May, 1921, issue of RADIO NEWS. This contained authoritative data of great importance to the amateur interested in C.W. and phone transmitters. It proved of help to many in designing apparatus for use with electron valves.

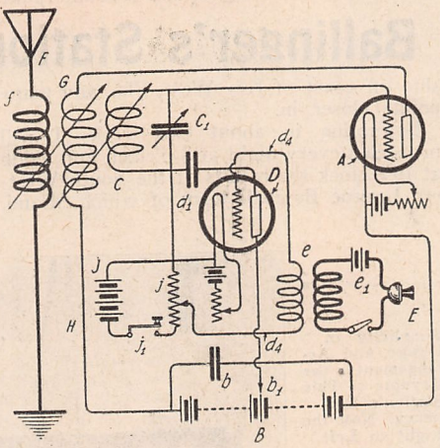
Mr. White has given numerous addresses before radio clubs and A. I. E. E. sections and is the author of several articles on radio topics. He is a member of Tau Beta Pi and Sigma Xi.

A Method of Eliminating the Carrier Wave in Radio Telephony

By R. HEATHER

THE methods of modulating wireless telephone circuits at the moment in general use, whilst all attaining their objectives to a greater or lesser degree, are comparatively inefficient when we come to review the attendant circuits of most of these methods of control, and the loss of energy involved. The writer has produced a combination of circuits—a schematic diagram of which is attached—wherein there are no sustained oscillations until such time as, by the impinging of sound waves on the microphone, the system is caused to oscillate, and ultimately radiate energy in the form of wholly modulated ether waves. The practical usefulness of a system entirely eliminating the surplus carrier wave is very great, particularly if the adoption of the system does not call for the use of delicately-balanced circuits and difficult adjustments. The circuits necessary for the system about to be described are not, for ordinary change-over work, at all complicated, and the adjustments are by no means difficult. Very good results have been obtained with powers from approximately two watts up to 50 watts with a radiating aerial, but for higher powers tests have only been carried out on a dummy aerial. The quality of received speech is excellent, and is not affected by the amount of power consumed at the transmitter; that is to say, the same circuits and the same modulating valve will handle high powers or low, depending upon the capacity of the power valve only. Naturally, the insulation of the circuits must be sufficiently high to insure against breakdown in cases where high voltages are used. This "condenser-leak modulation lends itself very effectively to duplex telephony, and with proper modification of the circuits shown here, the writer has been able to carry on conversations in the same way as with an ordinary telephone line without any switching whatsoever for the "receive," The clearness of speech, music, etc., is exceptionally good. The system will now be briefly described.

The main valve A is connected through the inductance G, which may be coupled to the coil *f* of the aerial *F*, to a suitable source of high potential, such as direct current, from the primary or secondary



Until Sound Waves are Impressed on the Microphone, no Sustained Oscillations are Generated in This Circuit, Hence the Absence of the Usual Carrier Wave.

battery B, or a dynamo, or rectified alternating current from an alternator or transformer. The filament *a* of the valve is connected to the negative side of the current supply, which may have a condenser *b* connected across it to provide an easy path for the flow of oscillatory energy when the valve A is in operation. The oscillatory circuit C comprising the inductance *c* and condenser c_1, and suitably coupled to the inductance G of the main circuit H, is connected to the grid a_1 of the valve A on one side, and at the other is connected to the filament *d* of the modulating valve D and also to a condenser d_1, the other side of which is connected to the anode d_2 of the modulating valve, which anode is in turn connected to the tapping b_1 taken off the main supply, or to a separate battery connected to the filament of the main valve, according to the type of modulating valve D employed.

The grid d_4 of the modulating valve may be connected up to the secondary of the step-up transformer *e*, in the primary of which is the microphone E and battery e_1, or the microphone E may be placed direct in the grid circuit d_4, the grid d_4 being kept normally at a definite negative potential with respect to its filament by means of a battery J and potentiometer *j*. With the valve circuits as above described, on adjusting the negative potential on the grid d_4 of the modulating valve D and the positive potential on the anode by tapping from the main current source B (or separate battery) connected to the filament of the main valve A, the system can be arranged to oscillate continuously, assuming that the oscillatory circuit connected to the grid of the main valve is turned to the frequency of the main circuit H. If, however, the negative potential on the grid d_4 of the modulating valve D is increased by the potentiometer *j* to such a value as just to cause the oscillations through the main valve A to stop, the system is very unstable, and any external disturbance impressing a positive charge on the grid of the modulating valve D will cause the system to oscillate to a greater or less amplitude according to the amount of the charge.

(*Continued on page* 1544)

THIS Department is open to all readers. It matters not whether subscribers or not. All photos are judged for best arrangement and efficiency of the apparatus, neatness of connections and general appearance. In order to increase the interest in this department, we prefer to publish photographs of stations accompanied by a picture of the owner.

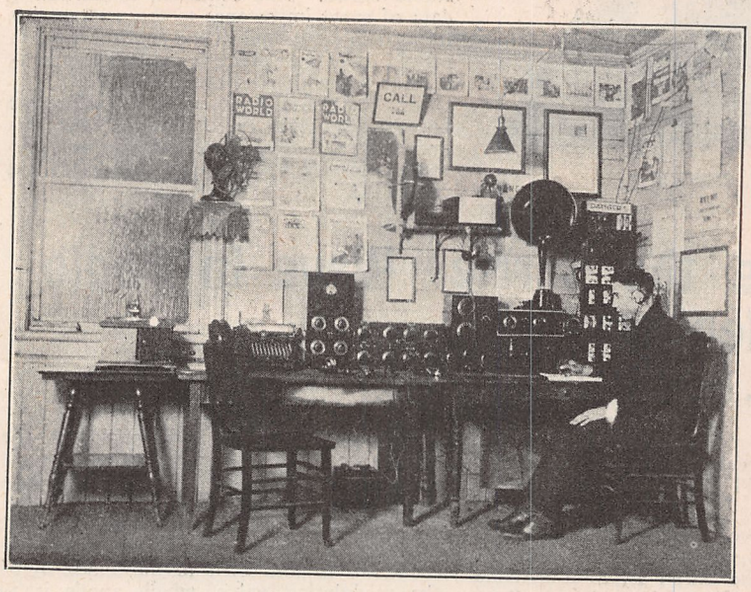
We prefer dark photos to light ones. The prize winning pictures must be on prints not smaller than 5 x 7". We cannot reproduce pictures smaller than 3½ x 3½". All pictures must bear name and address written in ink on the back. A letter of not less than 100 words giving full description of the station, aerial equipment, etc., must accompany the pictures.

PRIZES: One first monthly prize of $5.00. All other pictures will be paid for at the rate of $2.00 each.

H. E. Gaudet's Station

Canadian 1AA

This Month's Prize Winner



This is One of the First Canadian SStations, but There is Nothing of Antique Appearance. American Apparatus is in Evidence. On the Extreme Left is a C. W. and Phone Transmitter Followed by an Amrad Short Wave Receiver. The Magnavox Rests on Top of a Two-Stage Audio Frequency Amplifier. Mr. Gaudets' Spark Transmitter May be Seen on the Shelf Above the Receiving Apparatus

HERE is a photo of my Radio station. My aerial consists of four wires 100 ft. long supported by two towers 80 ft. high with a four wire lead in and a counterpoise for a ground. The set consists of the following instruments.

At the extreme right of the table is the switch board. Next to the switch board is a home made short wave regenerative receiver with detector and three step amplifier; for a detector I use an old type Auditron and it works splendidly. On the top of the detector and amplifier is another home made short wave receiver non-regenerative which I use with a two step radio frequency amplifier. Next to it is another Single Circuit receiver regenerative. After that comes the Amrad short wave receiver with two step audio frequency and two step radio frequency amplification; this set works wonderfully and a lot of long distance reception has been copied on it. After that is the home made C. W. and Phone set which is not yet completed. I have heard 73 American broadcasting stations and four Canadian broadcasting stations up to the present. At present I am using a ¼ K.W. spark transmitter consisting of a rotary gap, condenser, O. T. and a ¼ K.W. Acme transformer. The C.W. set will be completed in a week or so and I would like to hear from any amateur who happens to hear us.

HAROLD E. GAUDET,
Summerside P. E. I., Canada.

Bryce Ballinger's Station, 5LO

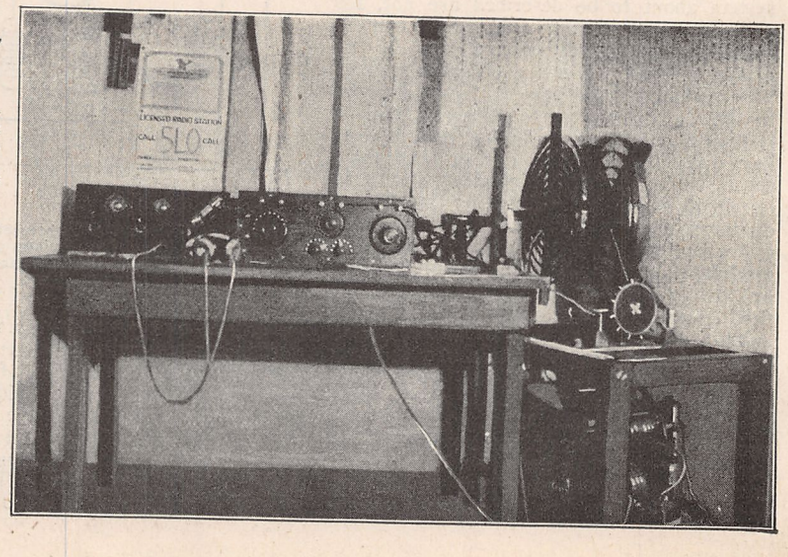
I AM sending you photographs and complete description of Radio Station 5LO.

My aerial is made up of three stranded copper wires 50 feet high and 80 feet long spaced 1¾ ft. apart. The ground system is of gas pipe. The receiver is of the Mid-West regenerative type with a wave length range of 150-600 meters. At the left of the picture is the detector and two stage amplifier panel. This panel is home made. The bulbs used are 1 tron bulb for detector and a Marconi and Moorhead tubes for amplifiers. I am using Brandes phones.

The transmitter consists of an old style Thordarson transformer. The condenser is a home-made glass plate one immersed in oil. The O.T. is also home-made and has six turns to the Primary and nine turns to the Secondary. The gap is of the rotary type (open) and rotates at an approximate speed of 5000 R.P.M. The whole transmitter is mounted on a frame made of 2 x 2's and makes a very compact transmitter.

With my receiver I have heard over 100 amateur stations within the last two weeks, representing the 5th, 9th, 8th, and 4th Districts. Have heard lots of C.W. and phone also. I also hear ships and on one occasion picked up an SOS distress signal. I have had very good success with my transmitter having been heard in Minn., Mich., Va., ship off coast of Key West, Fla., and many points closer in.

Beginning in about two weeks I will broadcast every night at 8 o'clock and again at 10 o'clock the results of the South Western League Baseball team of which Miami, Okla. is a member. I would be very much obliged if any amateurs hearing this QST or those who have previously heard my signals would write me. I have not had my license long enough to get my name in the call books.



Simplicity in Design and Arrangement is the Keynote of This Station's Efficiency. Note the Right to Left Arrangement of the Short Wave Receiver and Amplifier. This Makes Short Leads from the Antenna Switch Possible. The Method of Mounting the Spark Transmitter Appeals to Us

In closing I respectfully suggest to the editors of RADIO NEWS that they publish a "calls heard" department as it would undoubtedly benefit the amateurs in general.

Respectfully yours,

BRYCE BALLINGER,
Miami, Okla.

Station 2ABJ
Bronx, New York

THE accompanying picture is of station 2ABJ owned and operated by Nat. H. Sauberman of 789 East 163rd St., New York. This station is the outcome of many years of development. 2ABJ before the World War proudly boasted of a Marconi coherer set and a half inch spark coil "transmitter." The present set consists of a Grebe CR-8 short wave set and two-step amplifier. The Magnavox shown in the photo is very rarely used except to entertain an embryo music hound. The transmitter is not elaborate as

Mr. Sauberman's receiver is Recognized as a Grebe CR-8 and Two-Stage Amplifier. The Transmitter Which is Not Shown in the Photo is a 10-Watt C.W. Set.

2ABJ is mostly interested in amateur DX work and specializes on the receiving end. The transmitter is a 10-watt C.W. spark coil set with which good work has been done. Some of the DX stations heard are 1XM, 1AW, 1AJU, 4NT, 5XA, 6UW, 6EN, 9UH, and a host of others. The antenna is of the inverted L type 100 ft. long and 60 ft. high Since the taking of this picture a larger C.W. transmitter has been installed.

N. H. SAUBERMAN,

TRY THIS

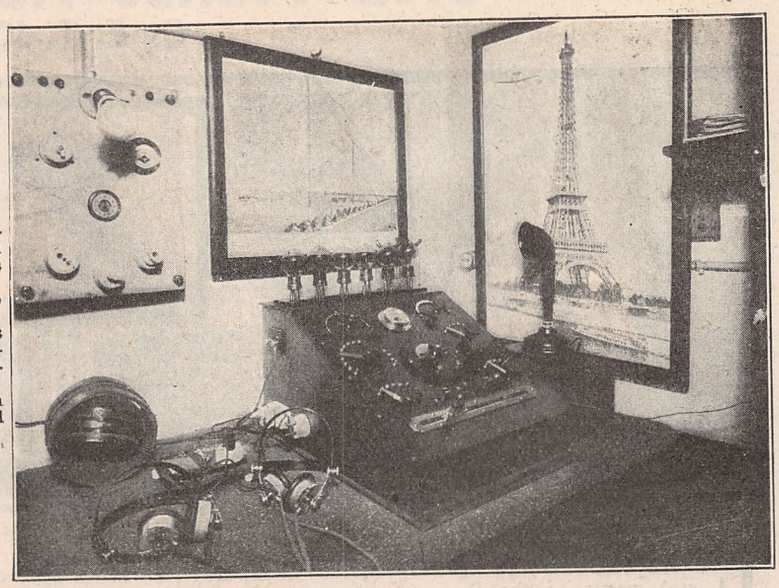
A western man is under the impression that his will is being controlled by radio. Asking for help he was advised to place a wire mesh scrap-basket over his head and ground it!

We are wondering if he is now living a peaceful life—and incidently, how he likes his food through a straw.

3AX

Contrary to the last call book, the call 3AX has been issued to Irving R. Sarbacher, 2644 Maryland Ave., Baltimore, Maryland. Any report on the C.W. or I.C.W. signals of 3AX will be appreciated.

Mr. Anen's Station at Luxembourg



The Desk-shaped Cabinet is Very Popular Abroad. This Receiver Certainly Has a Good Appearance. It is a Regenerative Outfit with Two Stages of Radio and Four Stages of Audio Frequency. All the Necessary Controls Are Mounted On an Ebonite Panel

MR. Anen, member of The Radio Club of Luxembourg, has mounted his apparatus in a desk-shaped box with the ebonite panel in an inclined position. Inside the box are mounted: the loading, tuning and reaction coils, the tuning condenser, the transformers for the 4-stage audio amplifier, the resistances and capacities of the 2-stage resistance-coupled Radio amplifier. The sliding contact of the tuning coil, the antenna-switch, the tuning switches, the rheostats and meters are mounted on the ebonite panel.

This set of clever and new design is entirely home-made and gives an extremely strong reception for telegraphy and telephony over a wave-length range of 500 to 25,000 meters. A loud-talker of American origin completes this remarkable outfit.

The Old Time Ham Gets Out

By JOHN F. BRONT

EXPERIMENTERS, friends and fellow amateurs! Lend me your ear phones. You know some time ago I swore by the beard of the pink-toed Prophet that never for me again in the radio game. I just laid away the old carborundum and potentiometer, the heterodyne, the autodyne and the iodine. Raised my right (or was it the left) to high Heaven and called the attention of Allah to the fact that I was done forever. No more sitting up at nights under a small town light company's 60-cycle carbon lamps. No more right end runs or flying tackles among the bargain hunters at the radio bazars. I told my friends, with a strong emphasis on the done. An old time spark coil murderer nodded his head wisely at my resolve. The matter was he nodded a little too wisely. He said, "of course, old top, you are done, sure you are, done for ever! Yeah! Like—er—well some warm place, you are." "S'truth," I protested with vehemence. "Uh huh," he said.

Well, I made up my mind that I would stick it out. I read all the magazines in the house, bought all neighborhood stands out and perused everything from Harper's to La Vie Parisienne. I started on "superpower of Will" or "How to Get Rich in Nineteen Days Through Force of Will," by Professor Moneybits. George Worthington from down the street dropped in and invited me to hear his new four-stage radio frequency outfit. I demurred. I recalled the brilliant words of the daring professor. I expounded and propounded and nearly got pounded in my vehement laying down of the professor's principles, so forcibly bringing out the deplorable subservience of man to material objects and common desires due solely to his lack of will power. Somehow down in my chest, I figured that I might need this power of will stuff and need it badly. I noticed the wife smiling demurely. I knew it was meant for me and my new, but as yet undeveloped fight, against the intrusion of the radio bug. Mary Gordon from a neighboring apartment house and an old friend of the family's rather a young friend of an old family, stated to me in a proudly shy manner that her uncle Tom had given her a duck of a radio receiving set. All one had to do was to turn a switch, and wouldn't I come up with the wife and hear it? Just once? Bill Marcell dropped in one afternoon and said, "Jack, I've got the dandiest radio set in town, won't you come up and listen to it? I copied FL and TSR last night!" I writhed in agony. Fat chance I would have to get away from radio with all this propaganda thrust under my nose! I was done with radio. Never again, per my resolution witnessed by Allah and probably properly entered in his log. I drew up my defenses and intrenched behind the abris and barricades I found in the professor's "Superpower of Will," the which would stave off any future attack from the radio epidemic. I was through completely; nevermore!

The wife came in and said, "Jack, the Thompsons had a fine entertainment last night over the radio. Madame XZCUPLM-XYL sang at AKDK and it was charming."

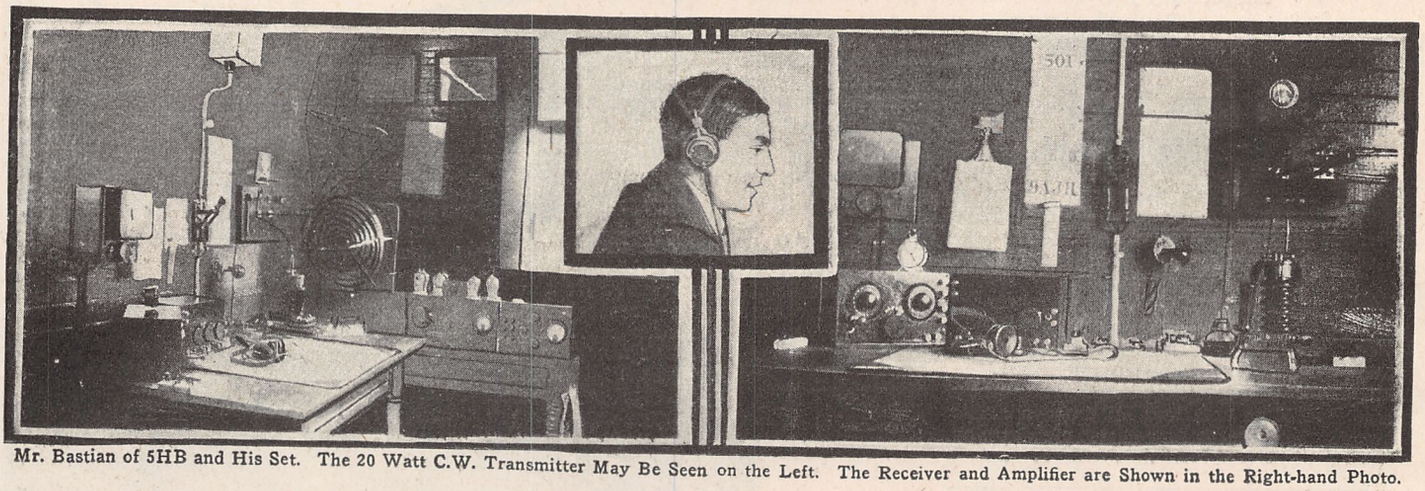
What! Was I to be "hounded and even bearded in my own—er—castle even by my own wife?" It looked to me like a fiendish plot all through. I told the wife in more certain and specific terms than I had ever used in the old honeymoon days, when we used to moon in the garden completely oblivious to the fact that there would be the ice bill and the light bill and the rent bill to look after, that I was being hounded to force me back into the madness concurred in my late attempt at radio reception, after I had been innoculated through exposure to some infected person or rather a million of them in one way or other.

She smiled indulgently, in fact more indulgently than she had ever done in our courting days. It was the last straw. I fled my emplacements behind my "Superpower of Will" and fled for the subway. Alighting up town I asked at my regular cigar stand

(*Continued on page* 1576)

5HB Makes Radio History

By E. T. JONES



Mr. Bastian of 5HB and His Set. The 20 Watt C.W. Transmitter May Be Seen on the Left. The Receiver and Amplifier are Shown in the Right-hand Photo.

FIGHTING hard to demonstrate the real mettle of the Radio Amateur. Mr. Louis Bastian of New Orleans, Louisiana (5HB), during the American Legion Convention, sent two complete messages to another Radio Amateur (7SC) at Seattle, Washington, some *twenty-two hundred miles distant.*

Mr. Bastian's home-made transmitting set, although having a rating of but TWENTY WATTS (4 UV 202 tubes), has been reaching out to every state in the union and amateurs in Canada report receiving his signals strong.

In addition to receiving 164 cards from amateurs scattered from California to Maine and down to Miami, Florida, and as far north as Canada, Mr. Bastian has succeeded in actually establishing communication and handling traffic with one or more stations in every one of the nine radio districts as follows:

Worked.....	1	One district station
"	3	Two district stations
"	3	Three district stations
" 14		Four district stations
" 27		Five district stations
"	1	Six district station
"	1	Seven district station
" 20		Eight district stations
" 48		Nine district stations

All this has been accomplished in three actual working months—the station having been closed down several times for repairs and during the hot months of the static season.

The thousands upon thousands of novices listening to radio concerts marvel at the reception of music from powerful stations some few hundred miles away; however, if they realized the true import of this epoch making record of Mr. Bastian they would no doubt realize the importance of *his kind.*

When I say "His Kind" I mean the amateur who also respects the novice and does not interfere with the broadcasted concerts. His license is not of the "Special" kind *and he furnished clear cut proof that the amateur does not require a special license to send on longer wavelengths which result in interfering with broadcast reception.*

With his station reaching out everywhere and to points thought impossible, he has not interfered with anyone as yet; which goes further to show that *there is no excuse for amateur interference.*

The time and effort it took Mr. Bastian to design and construct his station and install it "according to Hoyle" has resulted in practically 100 per cent efficiency, in output—in tuning—and in overall operation of the set.

Too many amateurs are careless in installing their sets and they often interfere with both the broadcast listeners and the DX relay amateurs—even though they have been tuned to apparently their prescribed *wavelength* by the inspector.

THE STATION

The first thing which greets the eye upon entering the Super-Amateur station which Mr. Bastian constructed are nine cards pinned on the wall—A card from each district beginning with the First District and ending up with a card from one of the Ninth District amateurs. This tells the whole story at a glance. One immediately endeavors to get a view of the apparatus which sent these waves over such great distances. It is a disappointment—for instead of a large bulky assortment of electrical machinery there is little or nothing more to be seen of the transmitter beyond the small 8" x 25" bakelite panel.

Just to the left of the modern noiseless transmitter is the old antiquated spark set which in its day was one of the best in the country. Even though it is extremely noisy in operation, it has (as far as Mr. Bastian is concerned) made its last "bark" and, as he mildly put it, "You can add that it is FOR SALE."

This antiquated spark set is rated at 500 watts with a maximum transmitting range of 800 miles in comparison to the modern 20 watt set which has a range of 2,200 miles.

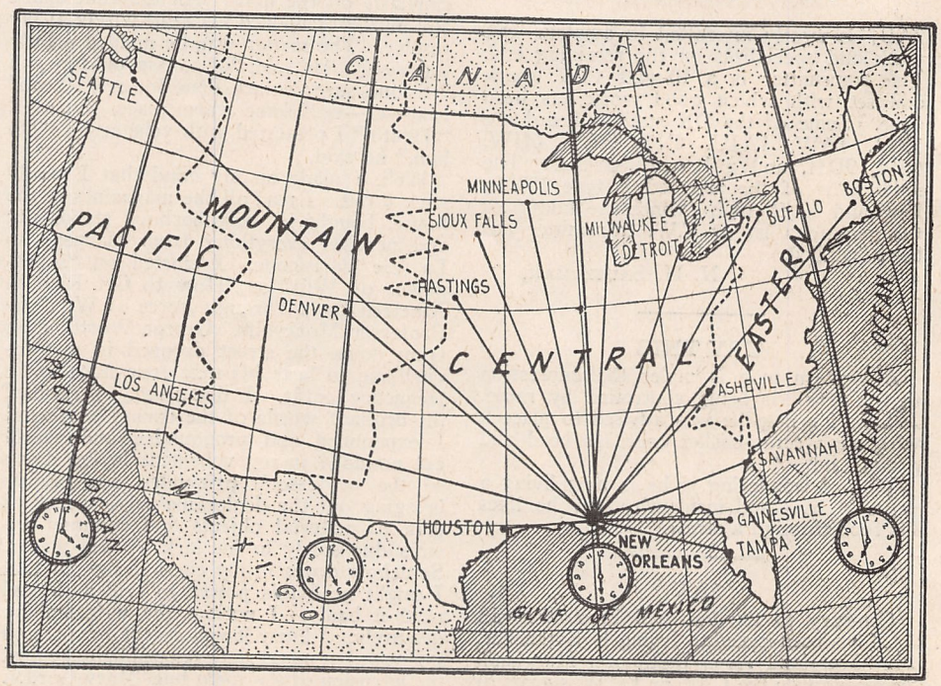
The old set then required approximately one watt to the mile while the new set requires approximately one watt for every hundred miles.

For those interested in reproducing the set, Mr. Bastian has constructed the following points of importance which will be of value.

The Hartley circuit shown in Fig. 1 is employed.
Radio Service Company tuning inductance (30 turns).
Somerville .002 grid condenser.
Faradon .002 plate stopping condenser.
Porcelain sockets.
1-plate milliammeter scale 0-300 Jewel.
1-Filament voltmeter scale 0-15.
(Tubes operate on eight volts.)
Thordason plate supply transformer—450 watt—1000-1500 volts.
Thordason filament heating transformer—150 watt—12 volts.
Acme 1½ Henry double choke coil.
2 Faradon UC-490 1 mfd. 1750 volt condensers.

The electrolytic rectifier is made up of 48 half-pint glasses (24 in each leg) half filled with a solution of *amonium phosphate.* The use of amonium phosphate is far su-

(*Continued on page* 1581)



A Map Showing the Distance Covered by 5HB. Stations in Every District have been worked. The 20 Watt Set Used Has a Range of 2200 Miles.

New DX Record Set By 6ZY, At Honolulu, Hawaii

FOR the benefit of the 25,000 radio amateurs, scattered from Canada to the Mexican border, who are interested in transmitting radio signals over greater and greater distances, the following story will tell of some remarkable records established on the night of October 28-29.

With a Beverage antenna connected to my receiver which was thoroughly described in last month's issue of RADIO NEWS, a new world's record was established for daylight transmission. At 3:25 P. M. the receiver was connected up and a test started to determine if everything was functioning properly. The whole ether universe was found to be wide open for here was 6PI, 6BCR, 7SC, 6CU, and 6AK chirping away in real midnight style. All of these fellows were logged from 3:28 P. M. to 4:11 P. M. Hawaiian time, which is near sun down on the Pacific Coast. The distance from Honolulu to Seattle is approximately 2800 statute miles. This is believed to be the greatest distance covered for daylight reception of amateurs. This distance is almost equivalent to Godley's record which he established during night time while in Scotland. Bear this in mind, please, because it will emphasize my record as one to be proud of.

It is also believed that on the night of Oct. 28-29 the writer established a new record in the amateur world for hearing amateurs from all districts, including Canada. Amateurs from every district were actually heard and conversations and messages were intercepted; 14 amateurs in the state of New York were logged, which sets another record for long distance reception. The distance to New York from Honolulu is near the six thousand mile mark. For the benefit of the reader I will print the calls and what information was intercepted from each amateur. It is not possible to reprint all the conversation and messages heard as space is not available. My log is kept on file and any information will be furnished anyone upon request.

Symbols used are as follows:

* Messages intercepted.
** Conversation intercepted.
† Calls and international signals intercepted.

IBKA†.

It is to be noted that only one "1" station was heard, which was IBKA. I will never forget how hard we tuned for a "1" station in order to make the radio log complete for every district. I was given a real thrill when IBKA was logged. I have written to this fellow thanking him for being on the job. He certainly must have a real C.W. transmitter as his signals were fairly clear. 3CO was heard several times and QSA enough for mill work. 3CO is located in Baltimore, Md., which is some 5,500 miles from Honolulu. 3AUU was heard at 5:09 P. M., which is about one hour before dark here in Hawaii. This is an exceptionally good record considering the power he employs and the distance from Hawaii to Virginia. 9AW, Toronto, Canada, came through in very good style. His signals were very QSA, even and dependable. That bird 6KA takes the prize for having

(*Continued on page* 1547)

Mr. Thomas Marshall Listening in on His Receiver. Remarkable Results Have Been Obtained With This Set, Using a Beverage Antenna. Stations in Every District of the United States Have Been Copied.

2FW**, 2LO**, 2FZ**, 2BGM**, 2AFB**, 2GO**†, 2AWL**.

Forty "6" stations were logged.

3AUU**, 3CO**, 3DH**.

4KM†, 4FG**, 4ID**, 4GH**, 4BY**.

5SK**, 5KC†, 5PX*, 5SM†, 5GV**, 5NK**, 5PB**, 5UO**, 5SF**, 5TC**, 5AEC**, 5ZAU**, 5EO**, 5EK†, 5AG**.

7SC, 7BK, 7HM, 7BJ, 7UU.

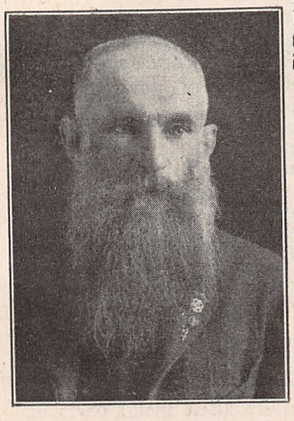
8CAZ†, 8BO†, 8BFM†, 8YD†**, 8BXA**, 8BEF**, 8XAE†, 8CGP†, 8BXH*, 8ANB†, 8OW**, 8AQQ**, 8AIO**, 8ML**, 8BEO**, 8ND**, 8ANJ**, 8PD†, 8CMI†, 8SP†, 8BFM†, 8AWM**, 8CBD**, 8CF**.

9AUL†, 9AMB**, 9BRG**, 9DPA†, 9BB†, 9ZAF**†, 9AWM**†, 9GK†, 9UU**, 9CP†, 9CG**, 9AXU†, 9AOG**†, 9AWS**, 9CCV**, 9CFY**, 9CIP**, 9DSM**, 9DKY**, 9ZN**, 9AW**† (Canadian), 9DTM**, 9LZ**, 9YAJ†, 9AM†, 9DPA†, 9BRG**, 9AUX**.

How Amateurs Can Serve

WE reproduce herewith a simple blank put out by O. H. Hovey, a young amateur of Perry, Okla., who has just completed his seventieth anniversary.

This young man may or may not have known in his heart and soul that the amateur is doomed unless he accomplishes something in the community. We are publishing this merely to show what real amateurs can do to become a leading force in this country. Mr. Hovey's letter follows herewith:



MR. O. H. HOVEY

"Perry, Oklahoma,

"*Editor,* RADIO NEWS:

"I've just got hold of your October issue, and can't help bothering you to express my great pleasure to see that while it has always been so superlatively good, each succeeding issue is better. I haven't missed an issue for years.

"I'm a Radio Fan of the 32d degree, and have got it *bad.* Hope to live long enough to get a broadcast from Heaven so as to get an idea of what it's like before I leave for there. How about it?

"Very truly yours, signing off,

"O. H. HOVEY."

Most amateurs whose time hangs heavily on their hands might do well to emulate the example set by Mr. Hovey.—EDITOR.

Mr. Hovey Serves His Community Well by Issuing Daily Market Reports and Weather Forecasts. This Shows One of the Standard Blanks Printed for This Purpose.

RADIO NEWS

Received at Hovey's Radio Station, Perry, Okla.

Received from WKY Station at Oklahoma City at 11 o'clock, Thursday, October 5, 1922.

CHICAGO GRAIN MARKET

At 11 A.M.

	Wheat,	Corn,	Oats,
Sept.			
Dec.	1.07-1/8	61-1/4	38-7/8
May	1.08-5/8	62-3/4	39-3/8
July	1.02-1/2	63-1/4	38-3/8

COTTON MARKET

	New York	New Orleans
		At 11 A.M.
Oct.		20.48
Dec		20.60
Jan.		20.68

At

Sept. Baseball received today commencing at 12:45, play by play.

Dec.

May

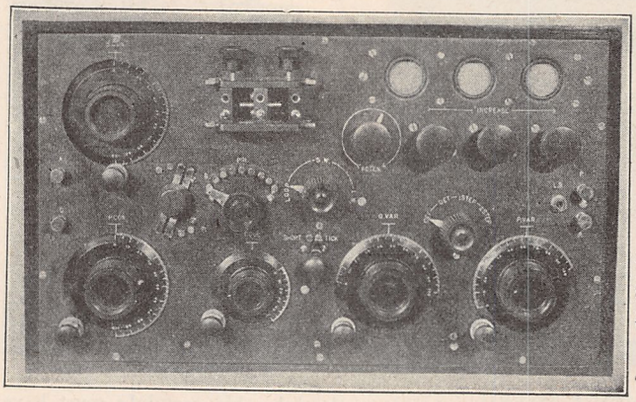
Weather Forecast for Oklahoma:

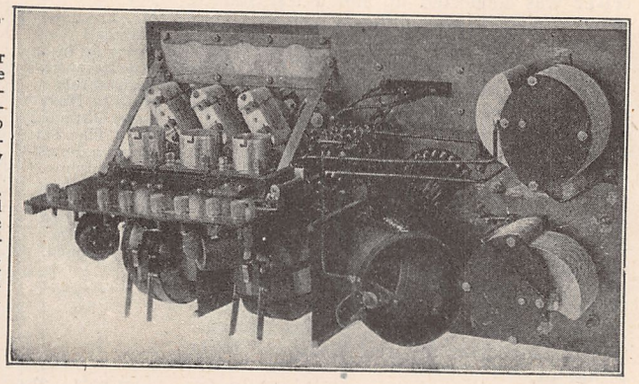
Thursday Night and Friday

Generally Fair Weather.

A Universal Receiver

By LOUIS J. GALLO



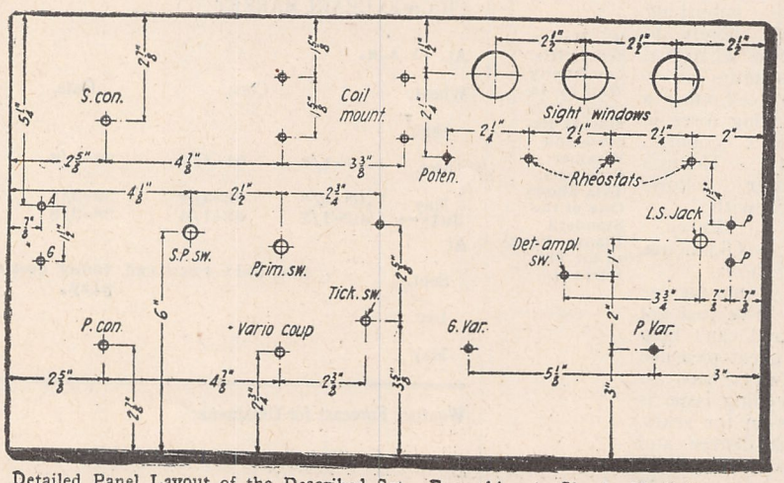


Front and Rear Views of the Completed Receiver. A Detector and Two Stages of Audio Frequency Amplification are Employed. This Set Will Cover a Wide Band of Wavelengths, Switches Being Provided for the Necessary Changes.

IN trying to describe this tuner, I shall first mention its possibilities. This knob with pointer marked Loop—S.W.—L.W. is a Storm Lee Multiplex switch and is used to effect the changes made; while at Loop the secondary honeycomb coil must be omitted. This arrangement, together with the Tickler and Short switch makes it possible to use an outside tuner on the same detector and amplifier as the aerial and ground terminals are then connected directly to the Grid and Filament with the two .001 condensers still in the circuit, one across and the other optional, either in series or parallel. These condensers are also automatically put in the primary and secondary of the S.W. and L. W. The other Multiplex switch is connected in the usual manner to the detector and amplifier with the exception of splitting the amplifier "B" batteries, that is, the first tube draws 60 volts while the second 200 volts for power; while using a Magnavox power tubes can be used up to 2.5 amp., as the Bradleystats can take care of this amount of current; also the last socket should have an extra slot cut in it to provide for other tubes. The jack marked L. S. is for input of Magnavox; when this plug is inserted, the phone terminals are automatically disconnected and the circuit to the fields of the Magnavox closed. This makes a very neat arrangement, as it is impossible to forget the fields all night, and whether the plug is forgotten in or not, if the detector bulb is extinguished, so is the field circuit opened. The beauty of this can also be appreciated by tuning in with phones and in one operation put on the loud speaker. When this tuner was hooked up, phone stations from 1,200 miles came in all over the house and on the L. W., IDO was copied. The S. W. consists of the customary variocoupler and two variometers with condensers and the L. W. honeycomb coils.

In building a set like this, it is well to use the best material, for, at the most, the cost will not exceed $100 and it is a tuner worth having. Parts required for it are as follows, and prices are approximately figured:

2	.001 V Condensers, Electron Co..	$11.00
2	Variometers, Remler	13.00
1	Variocoupler, Remler	5.50
1	3-Coil Mount, any make	5.00
3	Sockets, Optional	3.00
3	Rheostats, Bradleystats	5.55
1	Potentiometer, Paragon	1.75
1	Pri. switch with tape	1.00
1	Small switch, Remler	.40
2	Multiplex switches, Storm Lee..	10.00
1	Fil. Control jack, Federal	1.20
2	Audio Transformers, Acme unmounted	7.00
1	Grid Leak & Con., optional	1.50
4	4" Dials, Tuska	6.40
1	3" dial, Tuska	1.20
5	Verniers, Arkay	5.00
12	Binding posts, optional	2.00
1	pc. ¼" Bakelite 12"x21" ....about	9.00
1	pc. ⅛" Bakelite 4½x9½"	1.00
50	Strip .5000 shim brass	.20
30	⅜" square brass rod	.20
	Screws, nuts, tubing, etc., ... about	3.50
	Cabinet	6.50



Detailed Panel Layout of the Described Set. Everything is Clearly Marked for the Convenience of the Prospective Builder.

The multiplex switch for Loop—S. W. —L. W. must first have the cams changed; also, the last contacts used for filament must be changed, the last one being taken out and advanced one space further than originally. This can be better understood by purchasing one and studying it a while. The other remains the same, but must be mounted in a slanting position if Bradleystats are used for minimum of space. The brass shielding is placed over the entire back of the main panel and is put on in the same manner as tinfoil. The reason for using brass is obvious; it serves as a main bus line carryng the ground and negative filament circuit, and all respective circuits are connected directly and as short as possible to it, it being able to withstand soldering. This is impossible with tinfoil. Lots of wiring is saved by this method and the result is a much neater job. The supports for the cross shielding and sub-panel are made from the ⅜" square brass rod drilled and tapped at one end. The two for the shelving should be 9¼" long, and all should be connected electrically to the main shielding. This sub-panel can be made to any desired dimensions, but should not be more than 9½" long and the outer edge should be screwed to the ends of the supports. Using the material mentioned the dimensions are correct. The sockets are mounted on a cross length of this rod and the transformers are suspended from the bakelite, as far as possible from one another.

On the main panel all exposed screws are flat heads, their respective holes being countersunk carefully and all exposed metal parts are nickelplated, with the exception of the mesh covering sight windows, which is silverplated so as to stay white longer.

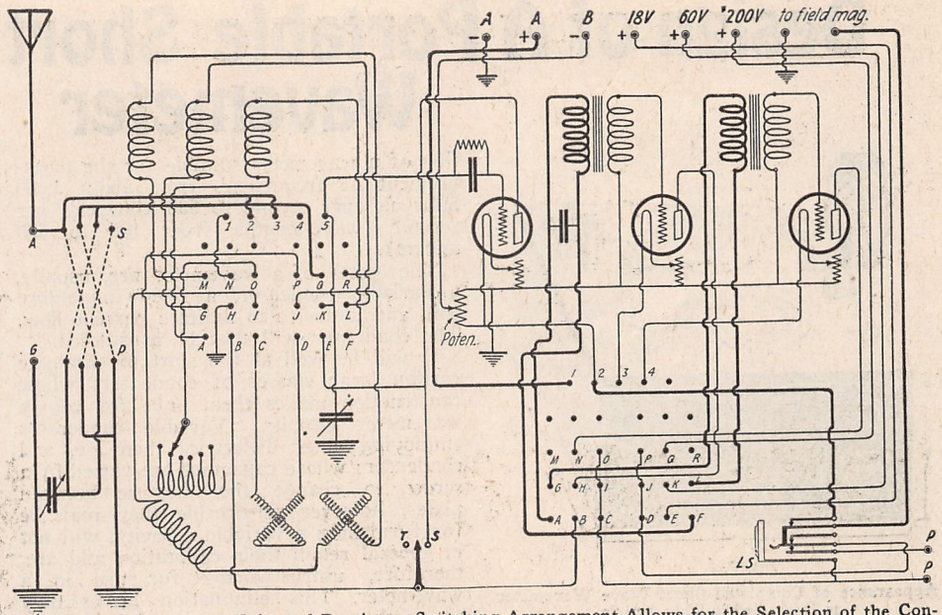
For the engraving, as these figures are not standard and as to have them made would be very costly, it is well to make the templates yourself. Procure a

quantity of 1-16" annealed brass sheeting, borrow a set of ½" steel dies and a small cold chisel about 3-16" wide and go to it. You may spoil one or two at the beginning, but with very little practice it will be found comparatively easy. When the set is finished some local dealer will let you have the use of his pantograph engraver for a small sum. It should be adjusted to a ratio of 2 to 1 which will leave about a ¼" lettering finished and just right. The usual manner of filling in is then applied and when dry enough, the whole panel is given an oiled and rubbed finish.

The suggestions offered in article "How to Wire a Radio Set Correctly" in the October issue of RADIO NEWS, are in exact accord with mine. In the panel drawing lay out, I have only shown the shaft holes and main screw holes so as to guide a possible builder, but as he will probably use other makes of instruments, the fitting holes will have to be figured individually. As a further suggestion I would mention buying all material before attempting to drill holes, as this enables you to place it more correctly and saves the bother and ugliness the useless ones.

The cabinet was built of ⅛" oak and stained dark, it was constructed so that the face of the panel fitted flush with the edge of the cabinet, leaving a border around ⅛" oak which gives the set a substantial and commercial appearance. The inner compartment measures 9"x5"x6" and holds a complete set of Giblin Remler Coils.

Anyone interested enough to desire further details on the construction of this set and who will communicate with me, I will be glad to answer if stamp is enclosed. Address Louis J. Gallo, c/o C. B. Moore Studio, 109 Baronne St., New Orleans, La.



Complete Circuit of the Universal Receiver. Switching Arrangement Allows for the Selection of the Conventional Three Circuit Tuner or Honeycomb Coils. Detector and Amplifier Are Also Controlled by a Switch Instead of the Usual Jacks.

Form Wound Coils

By S. E. WATSON

EVERY amateur electrical worker has occasion at various times to use form wound coils of special dimensions. In the construction of plain magnets or open core apparatus, the wire is usually wound in place directly upon the core. With dynamo or motor fields and closed core apparatus, it is usually impracticable, and, in some cases, impossible, to wind the wire in this way. Consequently, the coils must first be wound upon a form, after which they are removed, tapped, and slipped in place in the apparatus. Square or rectangular coils are needed more often than round ones, but the process of winding is the same in any case.

For the average job a form should be made of exactly the same length as is desired for the finished coil, making due allowance for the necessary insulation to be added later. Each of the other two dimensions should be about ⅛ inch greater than the corresponding dimensions of the core upon which the coil is to be placed. A block of wood planed to the oversize dimensions indicated above, and sawed to the desired length is the most convenient kind of core form. A ¼-inch hole is bored through the longitudinal axis of this block and receives the axle used in rotating the form. The appearance of the finished block is shown in Fig. 1.

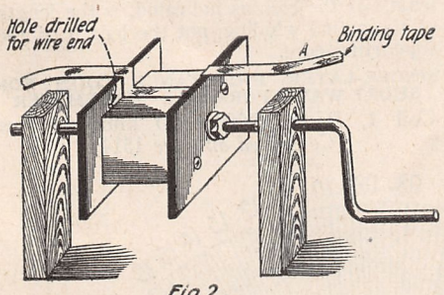


Fig. 2

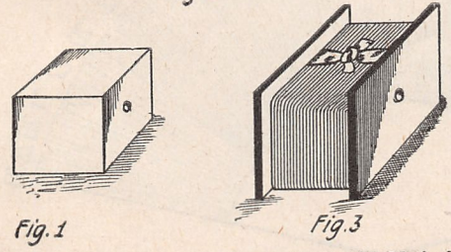


Fig. 1 Fig. 3

The Above Illustrations Show Clearly the Method of Constructing the Form and the Means of Winding the Coil.

Two end pieces of suitable size are made from thin board and a ¼ inch hole is bored in the center of each. One end piece is screwed to each end of the core, its center hole coinciding with that in the core. The spool thus formed is slipped on to a ¼-inch rod which has one end threaded for several inches, and the other end bent in the form of a crank. A tap is screwed up tightly to each end of the spool, and the whole is mounted as shown in Fig. 2. The bearings are simply wooden uprights with holes for the axle. If all work has been done with reasonable accuracy, the spool should show no tendency to wobble when the crank is turned.

The first step before winding the coil is to be sure that it will slip off the core readily when it is finished. Wind on the core a single layer of small hard-twisted cord. This layer must be wound perfectly smooth and the ends should be brought out through small holes in the end pieces. Wrap upon this layer two or three thicknesses of thin, stiff paper, just wide enough to come flush against both ends. Glue both tabs of the paper slightly, just enough to hold it in place.

On each side of the core, and parallel to the axis, glue a strip of narrow cloth tape as shown at A, Fig. 2, allowing each end to come up from the core along the end pieces, and fasten temporarily upon the outside. The tape ends must be of sufficient length to tie over the coil when it is wound, thus providing a method of binding it tightly in the process of removal. If the coil is to be a large one, two or more pieces of tape should be placed on each side of the form. After these binders are in place, paint the core with shellac or insulating paint.

Pass one end of the wire to be wound through a small hole drilled through one end-piece. Draw several inches of the wire through and fasten securely by wrapping around the shaft. Wind the required number of turns on the spool, laying each turn as closely as possible against the preceding one. Paint each layer, as it is wound, with a liberal coat of insulating paint, and allow it to partly dry before putting on the next layer. Wire—especially enameled wire—may be placed much more satisfactorily if it is wound on a bed of paint which has been allowed to dry just to the point of tackiness. When all the winding is in place paint the last layer, release the tab ends and tie each piece of tape firmly across the coil, as shown in Fig. 3. Allow time for the paint to harden before removing the coil. Passing just sufficient current through the coil to warm up the wire will hasten the drying.

Take the form from the axle, remove one of the heads, and grasp the end of the layer of string. By pulling in the direction parallel to the axis, the string may be removed, thus leaving a free space between the coil and the core. Remove the coil from the core, tape it and it is finished.

In the final taping the binding tabs should be removed, but it is not necessary to remove the paper. Narrow tape is best, and makes a much neater job on small coils. Each turn should overlap the preceding one by half its width. Going once around the coil with tape in this way gives two thicknesses at every point, and this is usually sufficient.

SHEET CELLULOID

I wish to call the attention of all amateur constructors to the advantages of sheet celluloid in making radio apparatus. It is undoubtedly as good an insulator as bakelite and far more ornamental, if the "grained" sheet used by piano manufacturers for "ivories" be used; it may be obtained from any piano house. Its advantage is that different parts may be glued together with "celluloid putty" (made by filling a 4-oz. bottle half full of equal parts of ether and denatured alcohol and then adding all the "scraps" of cut celluloid one can get into the bottle. Stir with a stick after 24 hours). "Basket ball" variometers and vario-couplers can be easily made by cutting out the forms and moulding in boiling water. Any shape

(*Continued on page* 1540)

Design of A Portable Short Wave Radio Wavemeter

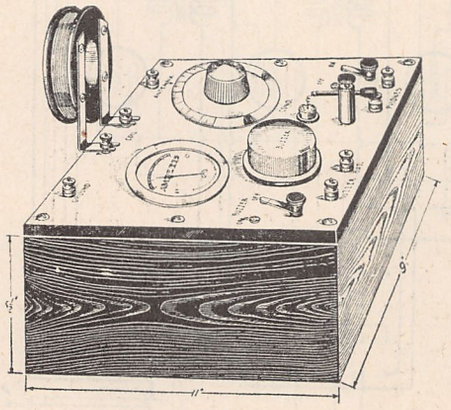


Figure 1

Appearance of Completed Short Wave Wavemeter as Described in This Article.

A WAVEMETER is a device for measuring the frequency or the length of radio waves. Radio waves always travel with the same velocity, and if the frequency is known the wave-length is also known.

Resonance is a most fundamental phenomenon of radio. When the inductance and capacity of a circuit, on which an alternating electromotive force is impressed, are adjusted so that the impedance of the circuit is a minimum and the current flowing in the circuit is a maximum, the circuit is said to be in resonance. For information regarding resonance and the measurement of wave-length, reference may be made to "The Principles Underlying Radio Communication," Signal Corps Radio Communication Pamphlet No. 40, and to Bureau of Standards Circular No. 74. These publications may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Amateur radio stations in the United States are at present required by law, when transmitting, to use wave-lengths not exceeding 200 meters, and it is, therefore, important that amateur operators should have a wavemeter available so that they may adjust their transmitting sets to comply with the law, and it is necessary that this wavemeter should be adapted to measure short wave-lengths such as 200 meters. Other comparatively short wave-lengths, such as 360 and 485 meters, are now used for radio telephone broadcasting, and it is important to have a wavemeter which can measure these wave-lengths. The Radio Telephony Conference, which met in Washington in February, 1922, recommended narrow bands of waves for particular services, some bands being only 10 meters wide. Stations which must work within such narrow bands must be provided with well-designed wavemeters if they are to comply with the requirements of the law. The design of a portable short-wave wavemeter is therefore a matter of importance. It is the purpose of this article to point out the most important considerations in the design of such a wavemeter, and to describe the construction of a wavemeter suitable for the measurement of frequencies from about 3,000 kilocycles per second to 530 kilocycles per second (wave-lengths from 100 to 570 meters).

The parts of a wavemeter are, usually, a variable condenser, a fixed inductance coil, and a device to indicate current flow. The condenser will first be considered.

It will be well at the start to eliminate certain large classes of condensers whose construction makes them unfit for use in wavemeter circuits. Variable condensers employing other dielectrics than air, and condensers whose capacities are varied by a screw to change the distance between plates, however serviceable they may be for furnishing a variable capacity, will not in general retain their calibration and are, therefore, untrustworthy for use in a wavemeter. This elimination leaves only air condensers whose capacity is varied by changing the overlapping area of parallel plates—the usual type of variable condenser. All condensers of this type can by no means be used in wavemeters. A condenser to be used in a wavemeter should have fairly heavy plates rigidly held together with ample tie rods and nuts, spacing washers of large diameter and sufficient thickness, adequate conical bearings, and, preferably, unimpeded rotation through 360 degrees of arc. Particulars in which variable condensers commonly fail to meet these and other requirements are: too thin plates, spring-supported bearings, extremely close spacing of plates, vertical or lateral play of the shaft in its bearings, contacts made by brushes wiping on movable parts, stops which in arresting the rotating plates shift them out of line, shifting scales or indices, and faulty workmanship which allows short-circuiting of the condenser at some settings. In general, anything that allows a capacity change without a change in scale reading or a change in reading without a capacity change destroys the usefulness of a condenser for wavemeter purposes. Some method of shielding is desirable to eliminate any change of condenser capacity owing to movements of surrounding bodies. The shield usually is a grounded metal case placed around the condenser.

The inductance coils will next be discussed. The requirements of a wavemeter coil are: (1) that its inductance be such that with the condenser used the desired range of wave frequency can be covered; (2) that its effective resistance and effective capacity be low; (3) that its inductance, resistance and capacity all be constant.

The first requirement, which has to do with the range of wave frequencies, will first be considered. It is well to restrict the part of the condenser scale used for frequency measurements to the sector between 15 deg. and 170 deg. on a scale graduated in degrees, or between the eighth division and ninety-fifth division on a scale graduated in hundredths. Since the capacity at 170 deg. or 95 hundredths will almost always be more than six times the capacity at 15 deg. or 8 hundredths, the frequency obtained with any one coil at the lower end of this region will be not less than about two and one-half times the frequency obtained with the same coil at the upper end. This will make it possible with one coil to cover the range from 3,000 to 1,200 kilocycles per second (100 to 250 meters) and with a second coil to cover the range from 1,330 to 530 kilocycles per second (from 225 to 570 meters).

The following table gives the number of turns required for two single-layer inductance coils which will cover approximately the stated ranges with each of the maximum capacities indicated in the table. It will be noted that the size of the wire and the spacing between turns are not specified. The inductance is nearly independent of the size of wire used, and the spacing is controlled by the number of turns and the length of the inductance coil, both of which are given. The length of the coil, as indicated, is the length of the actual winding, not the length of the supporting core.

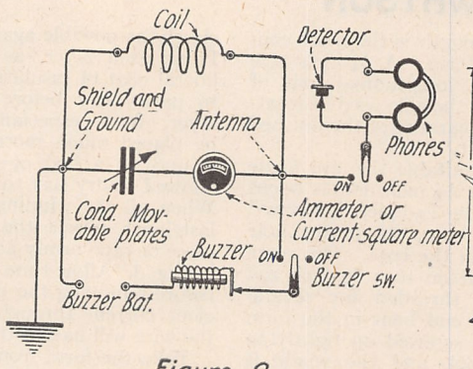


Figure 2

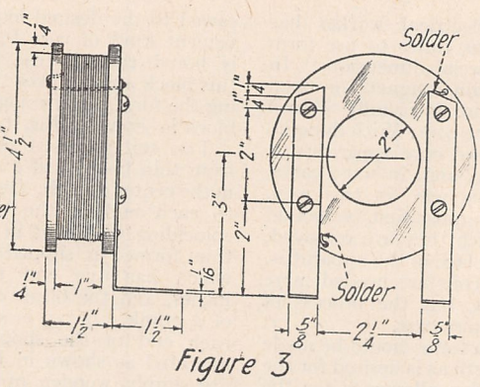


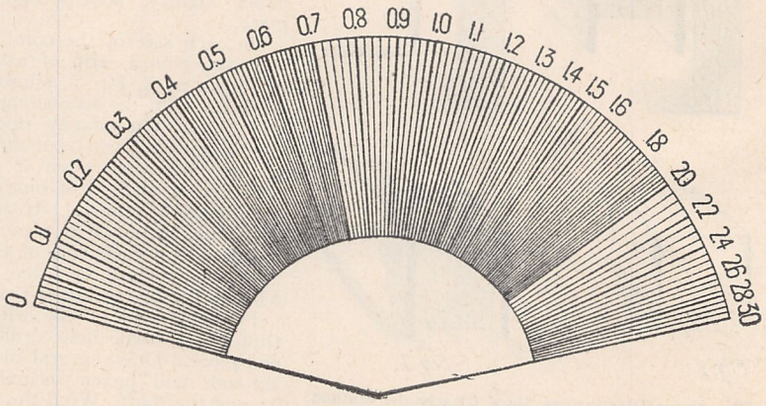
Figure 3

Fig. 2.—Circuit Diagram of the Wavemeter. Fig. 3.—Detailed Design and Dimensions of the Inductance Coil.

SINGLE-LAYER INDUCTANCE COILS FOR SHORT-WAVE PORTABLE WAVEMETER

Coil 1, Range 3,000-1,200 kilocycles per

(*Continued on page* 1514)



A Decremeter May be Made Out of the Wavemeter by Using the Above Scale on the Variable Condenser, Providing the Condenser has Semi-Circular Plates.

A Five Watt Telephone and Modulated C. W. Transmitter

By JESSE MARSTEN

WITH the advent of broadcasting, radio has come to the fore as one of the indoor sports and recreations of the public. This new radio public, which listens in every night to the broadcasted concerts and talks, expects to find the air relatively free from interference. This radio public outnumbers the radio amateurs many, many times. The amateurs—many of them operating spark coils or other spark transmitters, which of course furnish most of the interference—are, therefore, finding themselves constantly under fire from the new and inexperienced radio public.

For the amateur to answer that the interference is not due to him and that the fault lies in the type of receiver used by the lay public, is not to solve the problem. In the first place all amateurs do not transmit exactly on 200 meters, and they are prone to err more on the higher side of 200 meters than on the lower. In the second place the decrements of a good many of the amateur spark sets is not what the best practice demands. Finally when it comes to blaming the type of receiver used by the layman as being responsible for most of the interference, the amateur reaches a point where it is much easier to criticize than to offer practical remedying suggestions.

Some of the very amateurs who protest that they must have the use of the air, and that all the trouble lies in the single circuit receivers in use, fail to see that the cause of the trouble is very frequently under their very noses. To illustrate: In my neighborhood lives an amateur who possesses one of the multiplex receivers which are recommended for the novices. When it comes to reception he has all the frills that the most fastidious amateur will recommend. However, he prides himself on the fact that he is a real amateur, and, therefore, also has a transmitter if you please. He has—I should say, had—a spark coil transmitter which boasted a decrement curve as flat as the Sahara Desert. He broke in on any kind of a receiver and spoiled many a night's good entertainment for the neighborhood. To eliminate such an interference, I was willing to devote some of my time to designing a small five-watt buzzer modulated C. W. transmitter for him. He receives no further complaints now about interference.

The amateur should have no trouble obtaining information as to the circuits and construction of C. W. transmitters. In the different radio periodicals there appear from time to time designs of suitable sets. In the remainder of this article there will be described a five-watt C. W. transmitter from which the amateur may obtain many constructive suggestions. This set was built for use, in the Navy, on small flying boats. It delivers five watts to the antenna and operates on three wave-lengths: 335, 375 and 425 meters. In this set transmission is accomplished by buzzer modulated C. W., and by telephone. but no provision is made for straight C. W. This latter can be effected by very small changes, as will be shown later on.

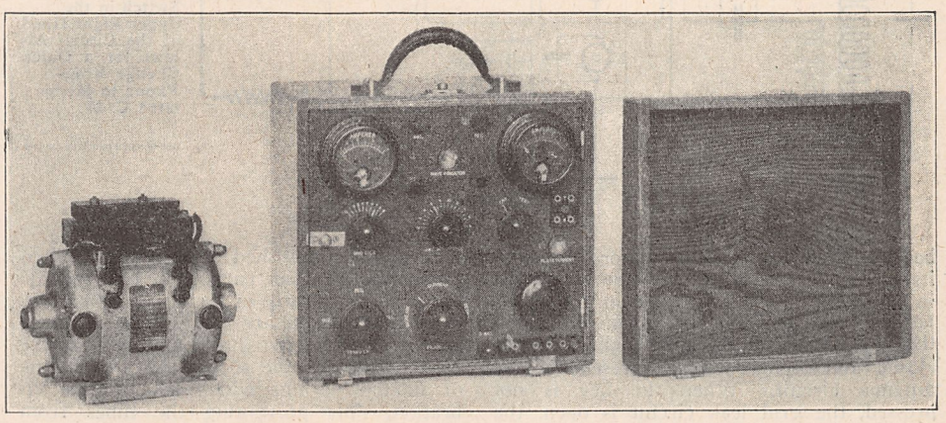


Fig. 4.—Front View of the Complete Portable Transmitter. The Two Meters at the Top Keep Check On the Filament Current and Radiation. On the Left is Shown the Small Generator Which Supplies the Necessary Plate Voltage.

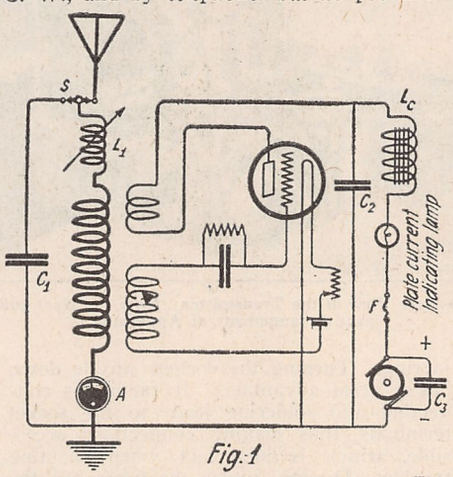


Fig. 1

The Oscillating Circuit of the Transmitter. This is the Meissner Circuit in Which the Components Are Independent of Each Other.

The circuits used in this set are shown schematically in Figs. 1 and 2, while Fig. 3 shows the entire circuit, which includes oscillator and modulator. Fig. 1 shows the oscillating circuit of the set. This is the "Meissner" circuit, in which the antenna. plate and grid circuits are distinct and independent, inductively coupled to one another. The antenna circuit, which is the load circuit, is fed by the output of the plate oil, while the feed-back coupling is obtained between the antenna and grid coils. The small variable inductance L is used to compensate far variations in antenna capacity, which occur while the plane is in flight. By means of the switch S condenser C may be connected in parallel with the antenna inductance. This condenser has a capacity equal to the estimated capacity of the plane antenna, and is used as a test artificial antenna. Before throwing the set on the antenna it can be connected to the artificial antenna by means of switch S and tested. The set may thus be adjusted and made to work on the artificial antenna and then thrown on the plane antenna when it should work about equally well. A grid condenser and leak are used in series with the grid coil to give the grid of the oscillating tube the proper biasing potential. In series with the plate circuit lead from the positive side of the generator is a lamp used as plate current indicator and an overload fuse F. The condenser C_3 shunting the generator leads affords protection to the generator for any high frequency kick-backs. and at the same time assists in smoothing out any commutator hum which is present. The condenser C_2 is likewise a by-pass for any radio frequency taking the path through the choke coil Lc.

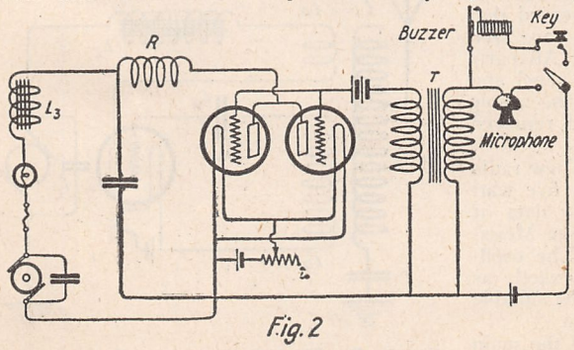


Fig. 2

The Heising System of Modulation is Employed as Shown, With the Two Tubes Connected in Parallel.

In Fig. 2 is shown a schematic drawing of the modulation circuit employed. Two tubes are used in parallel as modulators. These tubes are exactly the same as the tube used as the oscillator and are the General Electric Type T tubes having an output of five watts. The Heising system of modulation is here employed. The speech voltage is stepped up across the secondary terminals of the telephone transformer T and applied to the grids of the modulator tubes and amplified by these tubes. This amplified speech voltage is developed across the audio frequency choke coil Lc (Figs. 1 and 2) and impressed on the plate of the oscillator valve, thereby effecting modulation of the radio frequency generated by the oscillator tube. In order to prevent any radio frequency from backing up into the modulator tube, a radio frequency choke coil R (Fig. 2) is used between the plates of the oscillator tube and the modulator tubes. In order to secure maximum amplification of the speech voltage with minimum distortion, the modulator tubes must be worked on the straight line portion of the grid voltage-plate current curve. This is accomplished by using a negative biasing potential on the modulator grids, which potential is supplied by the use of two small dry cells. By means of the transfer switch S, either the buzzer or microphone may be used for modulation. The key K is used for keying when the buzzer is used.

To adapt this current for the transmission of straight C.W., the modulator filaments should be disconnected from the

*Photos by courtesy of General Electric Co.

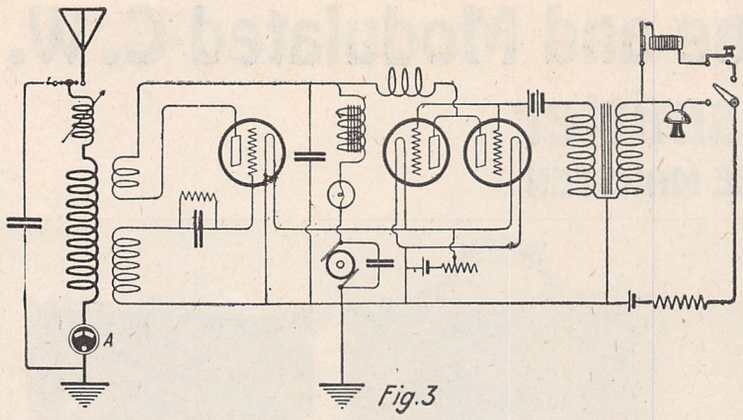


Fig. 3

The Complete Circuit of the Transmitter Here Described. The Switch in the Upper Right Hand of the Circuit Allows for a Quick Change From Phone to Modulated C. W.

battery. Thus only the oscillator valve and its circuit is operating. A key connected in series with the grid leak in the oscillator circuit will do the trick, for when the key is pressed the grid leak circuit is closed and oscillations are present in the antenna circuit. When the key is not pressed, the grid leak circuit is open, the negative charge of the grid cannot leak off and no oscillations result. Thus, C.W. oscillations are radiated from the antenna in accordance with signals sent out with the key.

Fig. 3 shows the complete circuit diagram including oscillator and modulator. At the top of the panel in Fig. 4 are seen the antenna and receiver binding posts, marked ANT and REC respectively. The meter on the left is a 0-1 radiation ammeter and that to the center right is a 0-6 filament current ammeter. Between the two meters in the center of the panel is a small lamp acting as a wave indicator, used when tuning the antenna circuit. Directly under the radiation ammeter at the left side of the panel is the grid coupling control for varying the coupling between grid and antenna coils. Next to this in the center of the panel is the control for the antenna variable inductance for compensating for small changes in antenna capacity. Next to this is the two-point test switch which connects the set either to the plane antenna marked ANT or to the artificial test antenna marked TEST. Directly under the microphone and key jacks, which are to the right of this test switch, is another small lamp used as the plate current indicator. At the bottom left of the set is the send-receive transfer switch. It has three operating positions; (1) Telephone transmission; (2) Buzzer modulated transmission; (3) Reception. When the switch is turned to the transmission points, it automatically starts the dynamotor. Next to this switch is the filament current control. Only one rheostat is used for regulating the current in the three tubes. The two binding posts alongside the rheostat are for an external grid battery. Finally, there is the buzzer and under it the four-point jacks for the power lead connections plugs coming from the battery and generator.

The rear view of the set, Fig. 5, shows the different elements mounted and connected. Naturally all the parts cannot be seen and distinguished as some are hidden from view by other parts. The tube mounting is shown clearly in the photograph. The three-tube sockets are mounted on one base and are tied to two horizontal bars at the four corners of the socket panel by means of flexible springs which take up the vibration, thus preventing the tubes from jarring. Turning the sockets upside down has a great advantage. It facilitates connecting and soldering leads to the socket terminals, thus making connections accessible, which is important when shooting trouble. Directly under the tubes are the "C" batteries for the modulator grids. To the right on the bottom are seen the plate circuit fuse and R.F. choke coil. At the extreme right, on the bottom, are seen six split contact springs making contact with curved metal bars on a cylindrical drum. This constitutes the send-receive transfer switch. The oscillating coil system is seen directly above this. The antenna and plate coil are wound on the same outer tube, inside of which can be seen the grid coil whose inductive relation to the others can be varied. All wires are covered with insulating tubing and it will be observed that all leads, without any exception, are well soldered to the connection posts. All parts are mounted on the back of the panel and securely fixed to same, so that the whole unit may be easily mounted and removed from the containing cabinet.

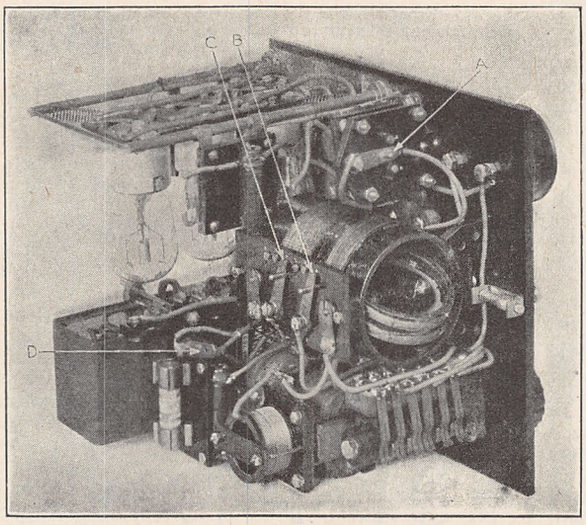


Fig. 5.—Rear View of the Transmitter. Note the Neat and Compact Arrangement of Apparatus.

In order to assist amateurs and new radio experimenters in building such a five watt set as described above, the design data of a five watt set employing the above Meissner circuit will be here given. The oscillating circuit to be used will be exactly as shown in Fig. 6. The data will be suitable for the average amateur's antenna.

The antenna circuit consists of the main antenna inductance L and the series condenser C. This series condenser will be found to be essential in almost every case, for in order to get the proper transfer of energy from plate to antenna, it is necessary to use a fair amount of inductance which will almost always raise the wavelength above the 200-meter mark. The series condenser functions in shortening the wave-length; it should have a value of about 0.0005 mfds, and should be constructed so that its losses are low. A good mica condenser is best. The importance of a good dielectric in the condenser C is often overlooked, but since the condenser carries the entire antenna current, the losses may be considerable if the dielectric is poor. Good mica condensers for transmitting purposes of the required value are available from very reliable manufacturers.

The antenna inductance L may be either one of two types: It may be a copper ribbon coil, in which case the diameter of the coil should be about 6" and about 30 to 35 turns used; ¼" by 1/32" ribbon is sufficient for most purposes. The great advantage of the copper strip coil (wound edgewise is the most convenient) is that air insulation is utilized, and once no solid insulating material is used, leakage losses and dielectric losses are reduced to a minimum. Furthermore, as is well known, copper strip reduces skin effect considerably. The other type of coil is one wound on an insulating tube, using round wire. If an insulating tube is used, the *very best* insulating material should be used. This cannot be emphasized too much, as the losses in a poorly insulated tube may be so great as to vitiate all other good qualities of the set. Bakelite dielecto is about the best material that can be used, and it is recommended that the tube be drilled with holes wherever feasible so as to insure as much air insulation as possible. The same number of turns as above may be used, namely about 30 to 35 turns. In this case the wire should be, if possible, Litzendraht, having good heavy cross section.

The plate coil Lp should be wound on an insulating tube about 4" or 4½" in diameter and should have about 30 turns of No. 18 or No. 20 B & S wire. The grid inductance Lg should be wound also on a 4" or 4½" tube and have about 20 turns of wire, 20 B & S gauge. In both cases the coils should be preferably mounted within the antenna coil, each being coupled to the antenna inductance. The particular arrangement for varying the inductive relations of plate and grid coils to the antenna coil can generally be left to the ingenuity of the constructor.

For most efficient operation it is necessary to use a grid condenser and leak which serve the purpose of giving the grid an average negative potential which is most suitable for maximum output and efficiency. The grid condenser Cg should be between 0.001 and 0.002 mfds. and the grid leak should be about 10,000 ohms. Frequently these values vary for different tubes and a

(*Continued on page* 1524)

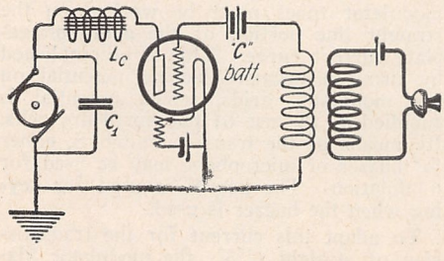


Fig. 7.—A Simple Form of Modulator Circuit That May Be Used.

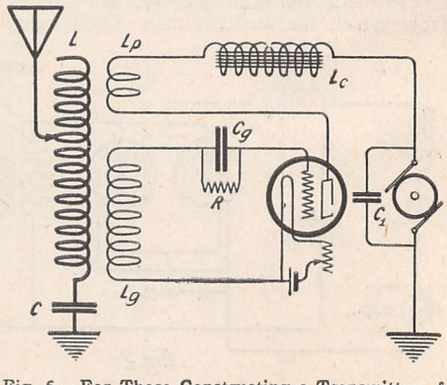


Fig. 6.—For Those Constructing a Transmitter of This Type, the Oscillating Circuit Above is Suggested.

Correspondence From Readers

FROM THE INVENTOR OF THE AMPLIFYING TRANSFORMERS

Editor RADIO NEWS:

I have noticed in your October number a short resumé of the work I have done in radio field.

Since you are so kind as to attract the attention of your readers to my name, I take this opportunity to direct the attention of your amateur readers to my U. S. Patent No. 1,405,523.

This patent covers not only "the famous 3ter," (audio frequency amplifier) but also describes and claims the design with which all efficient audio frequency transformers used in conjunction with a three electrode valve must comply.

It covers also the high frequency transformers with an iron magnetic circuit for the aperiodic amplification of radiocurrents.

It will surely be of interest to the amateurs to learn that according to a Patent of addition of 1917 a high frequency transformer for short wave lengths, is preferably provided with an air gap rather than with an excessive number of turns. This high frequency transformer for short waves may be constructed with open magnetic circuit and in particular the magnetic core may be made of iron wires (varnished or enameled) like telephone induction coils. However the diameter of the wire should be small, for example 10/100 to 18/100 of a millimeter.

MARIUS LATOUR,
Paris, France.

A SATISFIED READER

Editor, RADIO NEWS:

After reading the "Correspondence from Readers" and noting the many criticisms of the policy of the publishers, in giving so much on the radiophone and so little (?) on the so-called brass-pounding side of the science, I am compelled to take up my pen in defense of RADIO NEWS policies. I consider it one of the best publications before the radio public today. And I can find as much that is of benefit to the "old-timers" as I ever could. And as I have all the issues so far published, as well as those of the *Electrical Experimenter* back to January, 1916, I may not be considered as a newcomer. A great many of the articles on the radio telephone will apply equally to the radio telegraph, and I am sure that he who consistently reads RADIO NEWS will find as much to interest him as he ever did. Let us compare the issue of November, 1919, with the issue of November, 1922. The November, 1919, issue contained fifty-five pages, and was considered good value for the price ($1.50 per year), while the issue of November, 1922, contains 213 pages, an increase of 287 per cent, while the price has only increased 66⅔ per cent. What do you want for your money anyway?

Now, let's all stop kicking at the policies of the Editor and get behind and boost a little. I am sure we will all feel better for it. I feel that some of the editorials have been worth the price of the magazine and hope to see them continue. As to the stories, I enjoy reading them, too, and can see no harm in publishing one or two each month. Personally, I am very well satisfied with RADIO NEWS as it is now, and get many helpful ideas from its columns each month. Long may it prosper in the radio field, and enjoy the support of radio fans everywhere.

E. O. CRAMER,
Buffalo, N. Y.

3,545 MILES ON A SET

Editor, RADIO NEWS:

There is enclosed a copy of a message transmitted directly to San Francisco by the S. S. *Minnekahda* when 545 miles east of Ambrose Channel on November 18, the message traveling 545 miles over sea and about 3,000 miles across the continent.

The San Francisco station placed the message on the Postal Telegraph wire to New York. This communication was made with our 2-kw. arc transmitter installed on the S. S. *Minnekahda* and was the result of a wager between the Chief Operator of the S. S. *Minnekahda* and the traffic manager of this company. The traffic manager lost the bet.

C. J. PANNILL,
Vice-President
Independent Wireless Telegraph Co.

The Message

November 18, 1922
3POON7Radio Via SA SanFrancisco
SS MINNEKAHDA
HAHNE
INDEWIRTEL NEW YORK
545 EAST AMBROSE
NUNAN
1225pm

Radio Articles Appearing in the January Issue of Science and Invention

Talking Newspapers—By Clyde B. Fitch.
Winners in $100 Loud-Talker Contest.
Brooklyn Navy Yard Radio Station—Exclusive Article and Photos.
Radio Wrinkles, For Those Who Build Their Own—By A. P. Peck.
That First Radio Set—By Mike R. Farrods.
Broadcast Station Photos.
Broadcast Radiophone Station Call Letters Up to Date.
Radio for the Beginner—No. 11, How to Acquire a Simple Receiving Station—By Armstrong Perry.
Radio Oracle.

RECTIFIER FOR STORAGE BATTERIES

Editor, RADIO NEWS:

In your April-May number you published an article of mine describing a home-made "B" battery of 68 volts, and it must have struck a responsive chord among your readers, judging from the letters I received and am still receiving asking for further details of construction, etc. One thing in connection with the battery that appealed strongly to me was the ease of charging, due to the fact that we had direct current in the part of town in which we then lived. Since then, however, we have been changed to A. C., putting it up to us to devise a rectifier for charging. It may interest your readers to know how to do this:

Take a glass jar 6 inches in diameter and 8 inches deep, and lay across the top a strip of wood 1 inch square and 8 inches long. On one side of the strip of wood fasten a plate of aluminum 3 inches wide and 8 inches long, and on the other side fasten a lead plate of the same size, using half-inch wood screws, staggering the screws so there will be no chance of them touching and short-circuiting the plates. The plates should project about one inch above the supporting strip and drilled for binding posts, although connections may be made with battery clips if desired. The solution was made by placing a quart of water in the jar, adding six ounces of phosphoric acid and pouring in enough ammonia to neutralize the solution. In my case it required the contents of a twenty-five-cent bottle of ammonia purchased at a nearby grocery store. The rectifier should now be ready to use, and should be connected to the A. C. supply in series with the battery to be charged, and always with the aluminum plate connected to the positive terminal of the battery. It is a good plan to connect a lamp socket between the charger and battery for the purpose of inserting resistance, in the form of an incandescent lamp, to regulate the current, which may otherwise be too high. When the charger is functioning properly minute sparks will appear on the aluminum plate, at the surface, and possibly below the surface of the solution.

I have had no "B" battery troubles since building the battery eighteen months ago, described in RADIO NEWS, and I think it one of the best investments we ever made.

The lead plate for the rectifier was a piece of old lead pipe, split down one side and hammered flat; the screws, binding posts and glass jar came from our junk box, and the other materials cost as follows:

6 ounces phosphoric acid	$.40
1 bottle of ammonia	.25
1 piece aluminum	.15
Total cost	$.80

P. J. FAULKNER,
New York City.

IN FAVOR OF H. C. COILS

Editor RADIO NEWS:

I have seen in your last issue some comments on honey-comb coils. "The proof of the pudding is the eating thereof." I am using a regenerative honeycomb tuner, equipped with DeForest coils, 25, 35, 50, respectively; radiotron detector, six volt Eveready battery. My antenna consists of two 125 ft. seven-strand wires, running from opposite directions, connected only at the receiver, and sometimes used separately; it seems to make little difference as to which way they are used.

On this honey-comb outfit, using *detector alone,* no amplification whatever, I heard clearly and distinctly, one evening about two weeks ago the following stations: Newark (WOR), New York (WEAF), Lockport (WMAK), Harrisburg (WBAK), Philadelphia (WOO), Schenectady (WGY), Louisville (WHAS), Detroit (WWJ), Chicago (KYW), Ridgewood, L. I. (WHN), and both WSB and WGM, Atlanta, Ga. These stations were heard between 7 p. m. and 12 midnight. When WEAF and WJZ have broadcasted football games at the same time, one on 460, the other on 360 meters, I have used only my secondary condenser in tuning, and have received the report of both games with the greatest ease and with absolutely no intereference. Using *detector alone,* I have heard clearly San Juan, Porto Rico, and Havana, Cuba, and, from the opposite direction, Kansas City, Mo., representing a distance of approximately, I should say, thirteen to fourteen hundred miles in either direction.

REV. WILLIAM H. WATTE,
Paterson, N. J.

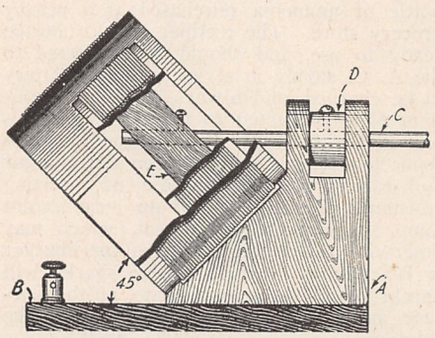
Awards of the $50 Wrinkle Contest

First Prize

EASILY CONSTRUCTED 180° VARIOCOUPLER

By A. Ferrand

THE object of this article is to describe the construction of a cheap and efficient 180° variocoupler. The device is so simple that hardly any explanations are necessary. The accompanying sketch shows plainly the details of construction.



Details of a Simple 180° Variocoupler Unique in Design and Construction.

The stator and rotor are pieces of cardboard cut out of old round cardboard boxes. These pieces should be given one or two coats of shellac before they are wound. The primary consists of 50 turns of No. 26 D. C. C. wire and the secondary of 40 turns. The shaft is a ¼" round brass rod bought in a ten-cent store. If this is not obtainable, a round lead pencil will work as well. Pieces A, E and base B are of wood (preferably hard wood) ½" thick. It is well when making piece E to leave it about ½" longer than necessary and then drill a hole for the shaft. The ends are cut off evenly coming from the edge of the shaft hole. This will insure a true running rotor. This piece is fastened and placed with glue. D can be of wood or metal and should fit close in the notch in the bracket, A, so as to prevent end-play of the shaft. The coupler can be mounted directly on the back of a panel if desired, in which case base B is omitted. Flexible leads from the primary and secondary coils are lead to their respective terminals in the receiving set or connected to four small binding posts mounted on the rear of the base. Taps may be taken off the primary coil at the most convenient positions. This variocoupler has been built by the writer at the cost of a few cents and has given as good results as any on the market.

Second Prize

COMBINATION CONDENSER AND COIL

By Malcolm P. Davis.

THIS condenser coil consists of a cardboard tube 3½" outside diameter and 4" high. Inside of this tube is pressed an aluminum drinking cup with straight sides and the handle removed. The cup should fit tight enough in the tube so as not to drop through but yet slide easily up and down in the cardboard tube. Around the outside of the tube, wind 50 turns of No. 30 insulated wire and take off taps at every 10 turns. To the bottom of the cup, fasten with a small brass screw, a piece of flexible wire and connect up as shown in the diagram. Brass or aluminum sheeting may be used in place of the cup mentioned by bending into cylinderical form, so that it fits well into the coil tube. A larger or smaller diameter tube may be used if desired, in which case use approximately 48' of wire in winding the coil. An upward or downward movement of the cup will provide the necessary wave-length variation between taps. The simple construction of this combination should appeal to the amateur constructor.

Prize Winners

First Prize $25

A. Ferrand,

Paterson, New Jersey

Second Prize $15

Malcolm P. Davis,

Rochester, New York.

Third Prize $10

Horace B. Phelps,

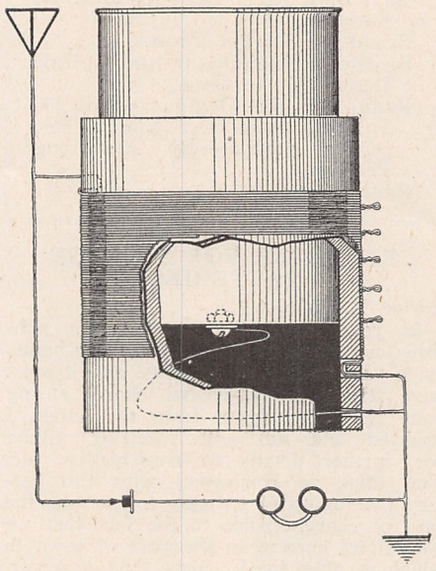
Troy, New York.

Third Prize

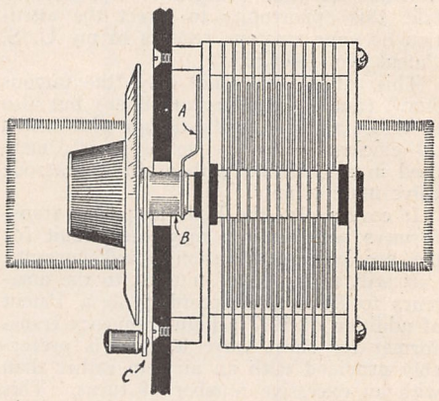
A CONDENSER VERNIER

By H. B. Phelphs.

THERE are a great many verniers now in use, but the one here described is superior to the present type in the following ways: It takes up no extra panel space; does not cause the condenser to turn hard; is manipulated by a long handle and is easily constructed. The design can be easily adapted to any condenser providing it has metal end-plates. This vernier attachment consists of three parts, namely; the handle, the bearing tube and the rotory plate. The bearing, B, is a piece of brass tubing which should make a good running fit on the condenser shaft and is just long enough to fit between the dial and the shoulder on the shaft. The handle, C, is a piece of stiff brass with an insulating knob, soldered to the outer end of the bearing tube. The rotary plate is soldered to the opposite end of the tube and should be soft copper or aluminum so that when the tube is in place, the plate can be bent into exactly the right position. In this form, the vernier will turn around with the main condenser shaft. This fact is not a serious objection, however, it may be remedied by placing a sheet of mica between the rotary plate and the end plate, allowing a little friction so as to keep the rotary plate from moving with the main control. This vernier attachment provides a means for the fine variation necessary in close tuning.



A Very Clever Combination of Capacity and Inductance in One Unit Allowing for Variation Between Taps.



This Vernier Attachment Can Be Easily Carried Out On Any Condenser With Metal End Plates.

ELIMINATING THAT HUM FROM THE LIGHT CURRENT

Being a radio fan and a constant reader of Radio News, my attention has been attracted several times to articles on induction due to the presence of electric feed wires being located near the antenna or the receiving set. In reading up several of these articles I find that they also render a few suggestions as to some possible means by which this induction hum can be eliminated. Almost always they first suggest that the antenna should be put at right angles to the feed wires. This method helps to a certain extent, but I have never been able to entirely eliminate the trouble by any of the plans that I have so far heard about. I am at present the owner of a two stage audio set and have had trouble with the induction from a light near the set. On local stations which come in loud it is not so noticeable but when I have the phones on my ears when bringing in out of town stations, they cannot be heard at all.

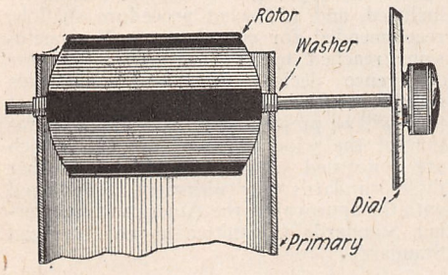
I have been experimenting to determine what would cut out this annoyance, but I could never completely remedy it. After experimenting with magnets and by pass condensers and the like I finally gave it up as a hard task. One day, by accident, I found a very simple method by which I was able to eliminate the hum completely. I have a pair of Brandes phones which have on the back of each phone two small terminals where the cord is attached. I found that by putting my finger tip on one of these terminals it eliminated the hum perfectly without harming the signal strength in any manner. By test of touching each terminal as in the aforesaid manner you may ascertain which is the terminal with which you are going to work. If you find that none of the terminals respond to the test just reverse the connection of your headset at the output terminal of your set, and then give it another test and you will find it will work out all right. After you have located the right terminal, loosen the

(*Continued on page* 1586)

Practical Hints for Amateur Constructors

A PRACTICAL TYPE OF BEARING

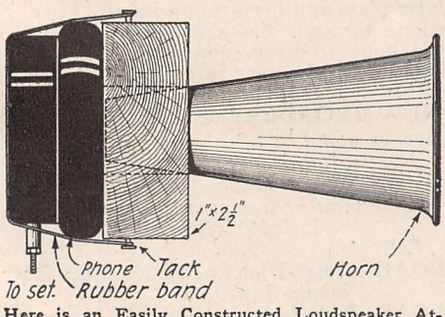
How to make the rotor fit snugly and revolve smoothly, is a question which no doubt confronts the amateur constructor, who builds his own variocoupler. When he fails to know how to accomplish this, the outcome of his work is discouraging. When revolving the rotor flops about and can be moved from side to side the result being that the axle supporting the rotor soon wears a large hole in the primary tube, providing the tube is cardboard. The remedy for this however, is simple:



A Snug Fitting Bearing is Easily Made by Winding Wire Into a Tight Coil to Fit the Rotor Shaft.

When ready to put the coupler together, take a piece of No. 15 enameled covered copper wire and wind four or five turns tightly about each rod which is to support the rotor. These will act as washers, and care should be exercised to see that the wires are wound close and tight. The next step is to slip both washers off the rods and make two holes in the primary tube, just a bit *smaller* than the outside diameter of the wire washers. As cardboard is soft, the washers can be easily "screwed" into the Primary tube, by way of these large holes. The rotor then is next slipped inside the Primary and both washers screwed tight, until it is found that there is no side play. The rotor can now be turned as much as desired, without fear of wearing a large hole in the primary tube where the rods pass through. The idea is worth trying, and it will be met with unanimous favor.

(Contributed by C. A. REBERGER.)



Here is an Easily Constructed Loudspeaker Attachment That Works Very Well.

SIMPLE LOUDSPEAKER ATTACHMENT

The device here described has been in use at my station for several months in connection with an ordinary phonograph horn. It is neat, simple, efficient and it may be made at practically no cost.

The materials are as follows:

1 block of soft wood 2½x2½x1".
2 common tacks.
1 rubber band.

The mehod of construction, is seen clearly by the drawing. The hole in the block is drilled slightly larger than the horn end if it tapers. If the horn end is not of conical shape. such as a phonograph tone arm, the hole is made just large enough to fit snugly. The receiver is placed as is shown in the cut. And it works!

Try to beat that for simplicity.

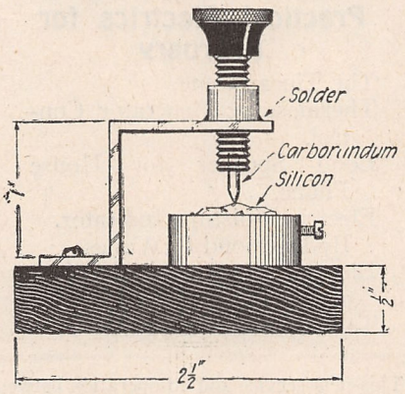
(Contributed by E. B. GOBRECHT.)

A CARBORUNDUM-SILICON CRYSTAL STAND

For the construction of a carborundum-silicon detector, the parts required are one piece of silicon, one piece of carborundum (crystal form), one piece of wood 2½ x 1½ inches, one piece of spring brass 2¾ x ½ inch, one crystal cup, one brass bolt and nut ¼ inch, one screw ⅜-inch long and two ⅝-inch flat head thread screws.

Bend the brass into shape as shown in the sketch, and drill one screw hole; also drill a 17/32-inch hole; solder the nut and drill 3/16-inch hole in one end of ¼-inch screw; fill this with solder and set carborundum in the solder while it is still hot. The crystal cup may be of any model. The carborundum must set very hard on the silicon, thus preventing the spot from being lost. This type of detector will keep the spot through the heaviest of thunderstorms and one may even pound on the table.

(Contributed by LOUYS HEGEL.)



This Combination of Carborundum and Silicon Makes a Very Stable Detector.

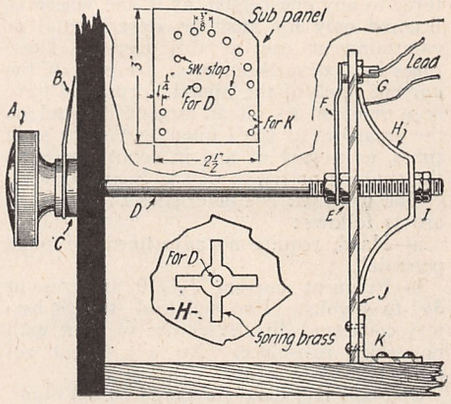
A BACKMOUNTED SWITCHLEVER

This switch lever is made from odds and ends found in any amateur radio station or laboratory.

The knob used is any ordinary radio knob which is made either of bakelite or composition, and can be procured at any radio supply house. This knob has a threaded shank into which is screwed a threaded rod about three inches long. On this, according to the diagram, is locked, by means of the threaded collar, an ordinary pointer. The switch blade is made of brass or phosphor bronze about 1½" long, and is held in place by locknuts at the proper distance on the threaded rod. The sub-panel was made of a piece of bakelite I had on hand. the contacts are spaced ⅜" apart on a radius of 1¼" also with the proper switch stops. The spider spring behind the sub-panel on the shaft gives enough tension to make very excellent contacts both for the lever and lead. This spider is made of some springy substance. The sub-panel may be mounted on the base of the variocoupler which made it necessary for me to use brass angles. Care should be taken that the hole in the panel corresponds to the hole on the sub-panel so as to give excellent alignment and working ease of operating the switch lever.

The panel can be engraved where the switch blade makes contact to points.

(Contributed by FREDERIC J. BRUNO)

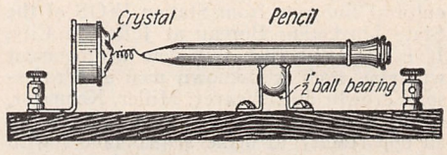


A Unique and Practical Type of Back Mounted Switch Lever.

A NOVEL DETECTOR

I present in this article a new detector stand. The control is universal and when once adjusted will stand quite a jar. The principal feature of this detector is the small sum for which it can be made. The pencil which is of the ever-sharp type can be purchased for ten cents and the rest of the parts are found in nearly every amateur's junk box.

I removed the lead from the pencil and soldered a catwhisker to the bar that runs through the center. If the type of pencil you purchase has no bar through the center, but just a clutch, use a piece of copper wire the size of the lead that is used in the pencil and solder the cat whisker to it. Next I soldered a ½" ball bearing about 1¾" from the blunt end of the pencil; this can be done very neatly by heating the ball with a gas flame and putting a drop of solder on the ball. Put a little flux on the pencil where it is to unite with ball and apply the pencil to the ball while the solder is still soft; remove the flame and let cool; you will then have a good joint. Next make two little angles of sheet brass through which drill a hole ¾", and two holes ⅛". The former hole is to form a socket for the ball, which sets between these two angles of brass when mounted on the base.



A Crystal Detector Using an Eversharp Pencil for Adjustment.

The crystal cup which is soldered or riveted to another brass angle is then made with two small holes for mounting it to the base. A knob for adjusting the pressure is made by using a composition finding post. Solder a small screw to the end of the pencil; an old battery terminal is very good for the purpose. Screw on the composition finding post and assemble and mount the parts on a base, which can be made of bakelite, rubber or a piece of hard wood.

Run one wire from the crystal cup to one binding post and one from one of the sockets to the other binding post,

(*Continued on page* 1593)

Radio Digest

SIGNAL CORPS SELLS TUBES

One Thousand Signal Corps Vacuum Tubes, Type VT-11, have been declared surplus and are offered for sale to the public at a price of $5.50 each, not more than three to any one person, as is and where is, licensed only for amateur, experimental or entertainment use, at this Depot. These tubes have never been used, are part of the current stock of the Signal Corps, and have been released to fill an urgent demand of the amateurs of the United States for such tubes, as a part of and in connection with the training activities of the Signal Corps.

The principal characteristics of the tubes are as follows:

a—Hard, require no adjustment of plate potential.

b—Filament current 1-1/10 amperes at 3½ to 4 volts. Two cell lead storage battery connected directly across filament with no series resistance. No adjustment required.

c—Plate impedance, average 20,000 ohms.

d—Plate voltage, 20 volts for detector, 40 volts for amplifier. Adjustable plate voltage not needed for either use.

e—Detector grid condenser, 100-200 micro-microfarad with two megohm leak connected to positive side of filament.

f—When used as an amplifier, grid circuit connects to negative side of filament.

g—Is effective radio and audio amplifier, detector, and will also oscillate freely in low output oscillator circuit.

h—Available for use in most existing commercial sets, care being taken to prevent using filament voltage greater than 4 volts.

i—Substantially similar to radiotron and fits radiotron receiving socket.

The sale is now being conducted by this office, and all correspondence regarding this sale should be forwarded to this office. Payment therefor must be either in cash, *certified check*, or postal money order made payable to the order of the *Finance Officer, U. S. Army*, and may be either mailed to this office, addressed to the Officer in Charge, Signal Section, Chicago General Intermediate Depot, 1819 West Pershing Road, Chicago, Ill., First Floor, Bldg. C, or delivered in person at this Depot.

THE COLLEGE OF AGRICULTURE BROUGHT TO MISSOURI FARMERS BY RADIO

According to Commissioner Arthur T. Nelson of the Missouri State Marketing Bureau arrangements are being made with Dean F. B. Mumford of the College of Agriculture for Radio Lectures on Agricultural Subjects from Station WOS of the State Marketing Bureau at Jefferson City. It is expected that this new arrangement will give such well-known men as Professors Trowbridge, Weaver, Miller, Kempster, Gardner, Ragsdale, Etheridge and others an opportunity to make acquaintances with Missouri farmers in a new way with short lectures on Animal Husbandry, Soils, Poultry, Horticulture, Dairying and Field Crops.

Resident professors in the College of Agriculture do not have equal opportunity with extension workers to reach the public. Their duties are confined to giving instruction to the young men and women enrolled in agriculture classes. Through the State Marketing Bureau Radio Station, however, these nationally-known Professors will be able to reach a large number of Missouri farmers, as well as other states with their messages. Thirty states are regularly "listening in" to Station WOS, says Mr. Nelson, and a total of thirty-nine states from New Hampshire to New Mexico, as well as Provinces in Canada and ships at sea, have heard the programs broadcasted five times daily from Jefferson City.

The services of WOS will also be extended to the Extension Service of the College of Agriculture, according to Commissioner Nelson. "Director A. J. Meyer can run over to Jefferson City and speak to every County Agent in Missouri with the greatest of ease and success. Some day it may be worked out so a large amount of extension instruction, as well as lectures on agricultural subjects may be imparted by radio."

Asked as to how many receiving sets in rural Missouri might be expected to "listen in" on lectures from Professors from the College of Agriculture, Colonel Nelson replied that with proper advance publicity on the progress it would be expected that a minimum of 500 receiving sets in rural Missouri would "tune in" to hear these noted men. "But the audience would by no means be limited to one person at each of the 500 receiving stations," said Commissioner Nelson. "Many of the receiving stations are now equipped with loud speakers around which groups of twenty-five to one hundred people may gather to hear lectures, market news and musical programs.

Some of the Interesting Articles Appearing in Practical Electrics for February

The Tinearphone.
Thermostatic Generator Control.
Loud Speaker for House Phone.
Electric Moisture Indicator.
By Raymond B. Wailes.
Electrostatic Ageing of Wines and Alcohols.
Talking and Singing Flms.

This new service and co-operation between the State Marketing Bureau and the College of Agriculture will go a long way toward giving the public an opportunity to make an acquaintance with the group of high-class men at the College of Agriculture at Columbia in a way that has never yet been made available to any other State University.

CONFERENCE ON RADIO STANDARDIZATION

The Bureau of Standards of the Department of Commerce has called a conference on radio standardization to be held on Friday, January 12, 1923, in New York City. The desirability of calling a general conference on radio standardization has been apparent in many ways, and this call is issued by the Bureau of Standards at the specific request of the following associations and organizations:

Institute of Radio Engineers.
National Radio Chamber of Commerce.
Radio Apparatus Section, Associated Manufacturers of Electrical Supplies.
National Retail and Dry Goods Association.
American Radio Relay League.
Radio Corporation of America.

These organizations have pointed out that there is need for greater uniformity in the methods of describing, rating, and testing of performance of radio apparatus.

Invitations are being issued to all of the national associations of an engineering and technical nature which are known to be interested in radio standardization. The representation of radio manufacturers will in general be through the trade associations of which they are members. While it is desired to make the conference thoroughly and broadly representative, it is expected that the organizations invited will limit their representation to one or two persons in order that the conference may be as effective as possible.

The purpose of the conference is to consider broadly (1) whether a formulation of standards for radio apparatus and service shall be made, (2) if so what general classes of apparatus or service should be included, and (3) what procedure shall be recommended for carrying out the conclusions reached by the conference. If the conference decides that radio standards should be formulated, it is expected that they will be prepared with special consideration of the wide range of interests which are concerned with the subject, and that these standards may ultimately be adopted with the approval of the American Engineering Standards Committee as an American Standard.

HAWAII ENJOYS KUO PROGRAM

Concert music and speech commemorative of Armistice Day, broadcast by "KUO" from "The Examiner" station on top of the Hearst building Saturday evening, was served all radio fans of the Hawaiian Islands.

Transmitted over the 2,100 miles of ocean, the electro-magnetic waves of radio were picked up by "KIE," the station of the Radio Corporation of America at Kokohead, T. H. The music and voice came in so strong and perfect that the operator switched the reception over on to the land wire and it was relayed into the office of the Honolulu "Star Bulletin."

VACUUM TUBE FOR A. C.

At a recent meeting of the Institute of Radio Engineers, a paper was presented on a Thimble Vacuum Tube by Dr. A. W. Hull. This tube was designed for use with an alternating current supply. An extra plate is incorporated within the vacuum, adjacent to the filament, which plays a double part in both rectifying the alternating current in conjunction with this extra plate and performing its other operations through the usual two elements. We hope to have more information on this tube in the near future.

NEW BROADCASTERS LICENSED

Supplemental List of Eleven Limited Commercial (Broadcasting) Stations on 360 Meters Licensed by Department of Commerce, Week Ended December 8

Call Station

WQAK—Appel-Higley Electric Co., Dubuque, Iowa.
WOAS—Bailey's Radio Shop, Middletown, Conn.
WRAN—Black Hawk Electric Co., Waterloo, Iowa.
WPAJ—Doolittle Radio Corp., New Haven, Conn.
WOAT—Hamp, Boyd Martell, Wilmington, Del.
KFDL—Knight-Campbell Music Co., Denver, Colo.
KFDJ—Oregon Agricultural College, Corvallis, Ore.
WQAB—Southwest Missouri State Teachers' College, Springfield, Mo.
WOAU—Sowder Bolling Piano Co., Evansville, Ind.
WPAR—Ward, R. A., Beloit, Kans.
WOAX—Wolff, Franklyn J., Trenton, N. J.

(*Continued on page* 1532)

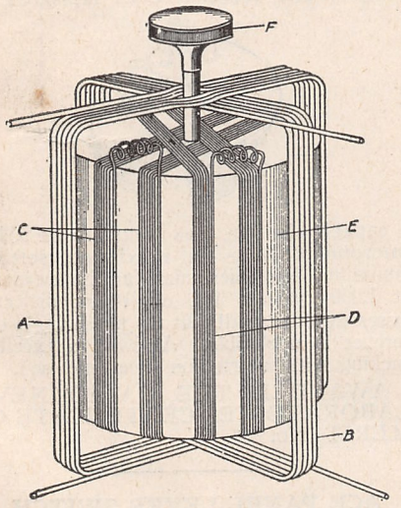
RADIOGONIOMETER

(Patent 1,426,137. Issued to George Maurice Wright, of Chesterfield, England, August 15, 1922.)

In the "aperiodic aerial" system of direction finding, using two fixed aerials and a radiogoniometer, it is necessary to make the coupling between the tuned search coil circuit and the aerial circuits as tight as possible. This condition is desirable firstly in order to minimize the loss in signal strength due to the method of tuning, and secondly to increase the ratio of signal strength to stray effects which tend to distort the ideal polar diagram of the system.

A radiogoniometer usually consists of windings disposed on two coaxial cylinders, the inner cylinder carrying the search coil winding and being capable of rotation. In order to make the coupling between field and search coil windings as large as possible it is necessary to make the cylinder carrying the search coil of as large a diameter as possible in order to bring the windings close together. The magnetic field inside the outer winding is, however, not uniform but is more intense in the neighborhood of the conductors themselves. Consequently as the search coil is rotated the law of coupling between it and each field winding does not follow the sine law required theoretically and errors are produced.

In the positions of symmetry, i. e., when the plane of the search coil either coincides with that of either aerial coil or lies midway between the two no error will exist. Consequently the error curve takes the form of a cyclic variation making four complete cycles per revolution of the search coil and if one aerial coil is parallel to the 0-180 line of the scale pointer system, then the points of zero error will be 0, 45, 90, 135, etc., and the points of maximum error about 22½, 67½, etc.



According to my invention I construct a radiogoniometer having a double search coil with its two windings in planes making an angle of substantially 45°.

My invention is illustrated by the accompanying drawing, in which A, B, are the two aerial coils and C, D, are the two windings of a search coil, the two windings being arranged substantially in planes making an angle of 45° with one another. These windings are arranged upon the surface of a cylinder E which can be rotated by means of a handle F.

The coils may be connected in series. In this case the total E. M. F. induced in the winding by the currents in the two aerials, is given by the algebraic sum of the E. M. F.'s in the individual coils. And though, as we have seen above, the difference of each E. M. F. from the ideal case may be quite considerable, yet since the differences are of opposite sign they cancel out and the radiogoniometer will read correctly in all positions of the search coil.

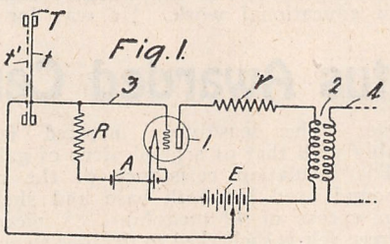
In some cases the error curve may not be quite symmetrical between successive zero points. In such a case the angle between the planes of the component coils of the search coil will not be exactly 45°. In this event the angle is chosen which gives the least mean error for all positions of the search coil.

CONNECTING TRANSMITTER TO VACUUM-TUBE AMPLIFIER

(Patent 1,422,837. Issued to Irving B. Crandall, of Nahant, Massachusetts, July 18, 1922.)

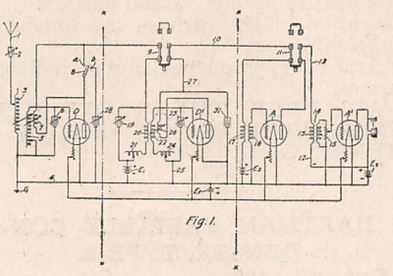
The invention in its generic aspect anticipates the use of either a condenser transmitter or a microphone transmitter, but is particularly adapted to the former case.

Special objects of the invention are to simplify the circuits and reduce the amount of battery required for the operation of such a combination of transmitter and amplifier. When a condenser transmitter is used this is accomplished by using a single battery or source of electrical energy for the two purposes of charging the transmitting condenser and operating the associated vacuum tube, and when a microphone transmitter is used the battery energizes the microphone and operates the vacuum tube.



Referring to Fig. 1, T is a condenser transmitter which consists essentially in a condenser, one of whose plates *t* is free to vibrate under the influence of sound waves and thereby change the electrical capacity of the condenser. Such transmitters are known in the art. One plate *t* of transmitter T is connected to the grid of a vacuum tube amplifier 1 of the audion type, while the other plate t" is connected to the filament through a portion of a battery E, which portion may be adjusted according to the potential desired across the plates of the condenser T. Plate *t* is also connected through a high resistance R to the filament, while between resistance R and the filament is connected the usual battery A. The output circuit of the vacuum tube amplifier contains the battery E, a transformer coil 2 and a resistance *r* which symbolizes the resistance of the output circuit.

In operation the battery E thus acts as a source of potential for charging the condenser transmitter T, and at the same time furnishes the current for the output circuit of the vacuum tube amplifier. When sound waves impinge upon the plate *t* and cause it to vibrate, a corresponding variation in the potential across the filament and grid occurs, which causes a corresponding variation of current in the output circuit. These variations are impressed upon a transmission line 4 through any suitable means, as a transformer 2.



RECEIVING STATION

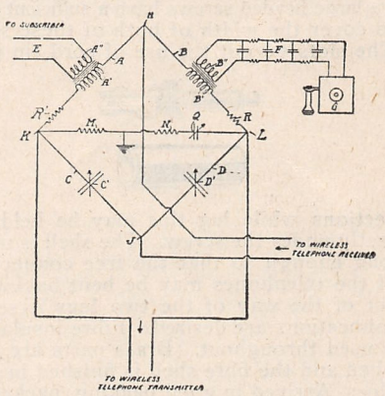
(Patent 1,415,992. Issued to Lewis M. Clement, of Newark, New Jersey, May 16, 1922.)

This invention relates to electromagnetic wave receiving stations.

An object of the invention is to produce a receiving station capable of receiving many kinds of signals efficiently, and particularly one in which a detector circuit may act to detect waves of one or more kinds and also in combination with another or other detecting circuit arrangements may detect waves having one or more different characteristics.

Referring to Fig. 1, the numeral 1 represents an antenna circuit containing adjustable capacity 2, coil 3, the antenna being grounded at G. To the ground is attached a conductor 4 forming a common ground for the whole system. Coil 3 is variably coupled to coil 5, both of which are of variable inductance and preferably movable with respect to each other. The upper end of coil 3 and lower end of coil 5 represent portions which may act to increase the inductance of their respective circuits but have substantially no coupling with other coils. Condenser 6 is in circuit with coil 5 whose terminals are across the input of detector tube D, the path to the filament of tube D being through ground connection 4. Capacities 2 and 6 and coils 3 and 5 represent any suitable means which may be variable over wide ranges, so that the antenna and circuit 5, 6 are capable of being tuned to frequencies varying from 20,000 or less to 1,000,000 or more. When switch 8 is on contact b, the output circuit of detector D extends from the plate through feed-back coil 7, which is variably coupled to coil 5, thence to double-throw switch 9. If switch 9 is in the "up" position, the path extends on through conductor 10 to switch 11. If switch 11 is in the "up" position, the path continues through conductor 12, coil 13, generator or battery E, and ground line 4, back to the filament of tube D. Variations of current in coil 13 are impressed upon coil 14 and by means of adjustable resistance 15, which forms a potentiometer, are impressed upon the grid-filament or input circuit of amplifying tube A'. In the output of A' is a receiver 16.

If greater amplification is desired, switch 11 can be thrown "down" and the coil 17 will be in the output of detector D and the variations will be impressed upon amplifier A through coil 18. Tube A will in this case impress its ouptut on tube A' for further amplification.



RADIO SIGNALING APPARATUS

(Patent 1,432,354. Issued to William Hockley Nottage, of Chelmsford, England, October 17, 1922.)

This invention relates to a system of telephony including both land lines and wireless, and its object is to provide an improved system whereby signals received by wireless may be transmitted over land lines and whereby a wireless transmitter may be operated by signals transmitted over land lines.

According to my invention I provide a Wheatstone bridge each of two adjacent arms of which is formed of one winding of a transformer, such, for instance, as those used in land line telephony for connecting the receiver to the line. To two opposite junctions of the bridge I connect the wireless receiver and to the other two junctions I connect the wireless transmitter, and I connect the land line to the other winding of the transformer of one arm.

With this arrangement signals coming in to the wireless receiver will not affect the wireless transmitter but will affect the land line so that they can be heard over that land line. Signals transmitted over the land line will not affect the wireless receiver but will affect the wireless transmitter by which they will be transmitted, because the latter is responsive to audible frequencies and the former is only affected by radio frequencies from the antenna.

The second inductive arm of the bridge is preferably formed of one winding of a transformer exactly similar to that connecting the land line already mentioned to the bridge.

It may be necessary to balance the land line by an artificial line in this second transformer,

(*Continued on page* 1526)

New Technical Director Appointed

WE take great pleasure in announcing the appointment of Prof. W. Palmer Powers, B.S., to the position of Technical Director of the Radio News Laboratories recently left vacant when Mr. L. M Clement resigned this position on account of added duties given him by the Western Electric Company.

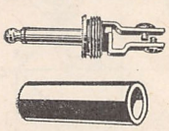
Professor Powers received his engineering education at the University of Pittsburgh, graduating in 1914 with the degree of B.S. in electrical engineering. He showed keen interest in radio prior to graduating, engaging in radio work for the Vermont State Forestry Department in the summer of 1912. He joined the engineering forces of the National Electric Signalling Company soon after graduating and has been continually identified with this organization until recently when the interests (then the International Radio Telegraph Company) were combined with the Westinghouse Electric and Manufacturing Company. He is well-known for his development of high frequency alternator controls and also his work on aircraft radio transmitters during the war. In addition to his articles on radio, Professor Powers has continuously engaged in educational work. He was for five years a member of the faculty of the Department of Electrical Engineering at Pratt Institute and is now Assistant Professor of Electrical Engineering at Stevens Institute of Technology, this being his second year at Stevens. During the past year he has conducted special research in sound in the graduating class of New York University.

Professor Powers is a member of the Institute of Radio Engineers, American Institute of Electrical Engineers and the Society for the Promotion of Electrical Education.

Apparatus Awarded Certificates

CARTER TU-WAY RADIO PLUG.

To permit the use of two phones, using but one plug, the Carter Radio Company, 209 South State Street, Chicago, Illinois, offer their Tu-Way radio plug. Standard design is followed throughout the plug with the exception of the contact lugs. Two slots are milled in each lug and the extra large headed screws have a sufficient area to cover the width of both of these slots. The slots permit the use of cord tip con-

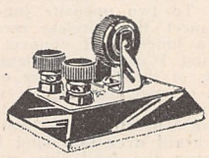


nections while lug tips may be held directly under the screw. The shell is made long enough so that the free connection of the telephones may be bent backward out of the way of the two lugs if series connections are desired. Fibre insulation is used throughout. Brass parts are polished and the fibre shell is finished in dull gloss. Arrived in good packing, packed in individual cartons.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT, No. 59.

GOLD-GRAIN DETECTOR

The Gold-Grain detector manufactured by the National Airphone Corporation, 16-22 Hudson Street, New York City, is intended for people who have tired of cat-whisker adjustments on their detectors.

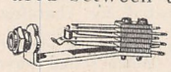


In the Gold-Grain detector, the sensitive spot is found by merely rotating the knurl on the pivoted shell. In this shell are sealed the crystal and the gold content compound used in making contact. When the shell is rotated, the grains in this compound come in contact with the crystal, thus finding a sensitive spot. The crystal is probably cerussite. The sensitivity compared favorably with that of a good piece of galena. The insulation resistance of the compound used for both base and shell is in excess of 40 megohms. A piece of green felt is shellacked to the base to absorb vibration. Arrived in excellent packing with instruction sheet enclosed.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT No. 63.

CARTER UNIVERSAL HOLD-TITE JACKS

The Carter Radio Company, 209 South State Street, Chicago, Illinois, depart from everyday practice in the manufacture of their jacks. The frame is so shaped that insulation stack-up is eliminated. Micarta insulation is used between the phosphor



bronze contact springs which are equipped with silver contacts. The nipple permits the jack to be mounted on panels from ⅛" to ¼" in thickness without the use of washers. The lugs are fanned to facilitate neat soldering. Metal parts, with the exception of the springs, are finished in polished nickel.

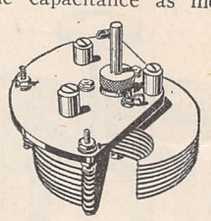
Arrived in good packing in individual cartons.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT, No. 58.

HARTMAN VARIABLE CONDENSER, TYPE S.

Some novel features are incorporated in the design of the Type S condenser manufactured by the Hartman Electric Manufacturing Company, Mansfield, Ohio.

The movable plates are cut in such a manner that the increasing capacity is relatively small at the beginning of the scale, a desirable feature when used as series antenna condenser. There is but one bearing which is exceptionally well made. It is in the form of a long bronze cone under an adjustable tension, giving smooth, accurate rotation. The plates are of heavy gauge aluminum, accurately spaced with washers. The end plate is made of hard rubber. Continuous rotation of the ¼" shaft is possible, since no stopping pins are incorporated in the design. The capacitance as measured on



a capacity bridge, was found to be 531.96 micromicrofarads at maximum setting; minimum, 8.34 micromicrofarads, measured at 1,000 cycles. The equivalent dielectric losses were so small that the phase angle difference is negligible. Arrived in excellent packing with instruction sheet enclosed.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT No. 64.

ACE PANEL LEVER SWITCH, TYPE LS.

An unusually well-constructed lever switch is made by the Precision Equipment Company, 2437-39 Gilbert Avenue, Cincinnati, Ohio.

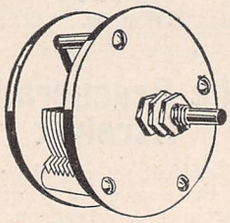
A contact lever 1⅛" long is provided with a back contact which rests on the bushing used for mounting the switch, assuring a good contact. This lever is fastened to the bakelite knob 1" in diameter by means of a hexagonal slot which fits over a nut on the shaft. Spring tension is used to hold the lever against the contact points. The bushing is 5/16" in diameter. Arrived in good packing in individual cartons.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT No. 62.

SUMTER VARIABLE CONDENSER

Desiring to obviate the necessity for drilling mounting holes, the Sumter Radio Mfg. Co., 103 S. Harvin Street, Sumter, S. C., offer their condenser which needs but one hole to be drilled for its mounting on a panel. A single bushing with two locknuts, entirely insulated from the shaft itself, is used to mount the condenser.

The end plates are of hard rubber composition and serve to support the condenser elements of moulded construction. A spring lever adjusts the tension on the shaft. Binding posts are provided to facilitate connections. The shaft accommodates a ¼" bore dial.



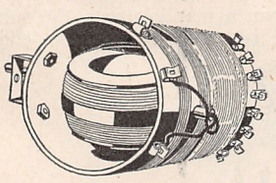
As measured on a capacity bridge the capacitance of this 23 plate condenser was found to be 387.9 mmf. at maximum setting and 14.35 mmf. at minimum setting, measured at 1000 cycles. The equivalent dielectric resistance was 15 ohms at each setting. The phase angle differences corresponding to these readings were 1′ and 20′, respectively.

Arrived in good packing with descriptive literature.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 50.

NELSON MEDIUM WAVE COUPLER

This single circuit tuning device is manufactured by the I. R. Nelson Co., Bond Street, Newark, N. J. On a bakelite tube 6½" long and 3¼" in diameter, a coil of double cotton covered wire is bank wound in three layers for the longer waves. This winding is continued, single layered, for the short waves. Just inside of this short wave portion of the coil, a winding on a wooden rotor serves as the feed back or tickler coil. Pigtail connections complete the circuit to this rotor. which is limited to a 180° rotation by means of a stopping pin. The shaft accommodates a ¼" bore dial.



There are eight taps for intermediate waves brought off from the bank winding to Fahnestock clips on the end of the bakelite tube. A transparent compound is coated over the windings to prevent the absorption of moisture and the possible loosening of the turns. Two brass brackets serve to support the unit when mounted.

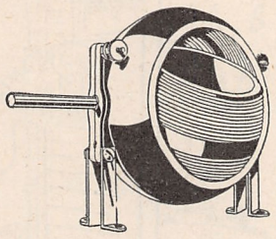
On the Laboratories' antenna the coupler responded to a range of wave lengths between 200 and 3,000 meters. Regeneration was obtainable all over this range.

Arrived in good packing with no instruction leaflet enclosed.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 48.

GOLD SEAL VARIOMETER TYPE BC

This variometer, moulded from a phenol compound is manufactured by the Standard Variometer Co., Inc., of City Point, Va. A pleasing appearance is presented by the contrast of the polished



metal work against the maroon colored shell. The windings are of green silk covered wire, with just a small amount of adhesive solution on the stator. The rotor winding is not coated at all. The ½" brass shaft passes through split bushings which serve as bearings. It is through these bushings that the circuit to the rotor is completed. Four nickel-plated feet are provided for table mounting, as no provision has been made for panel mounting.

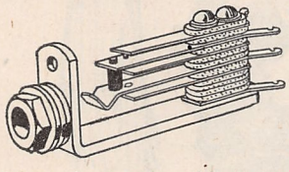
The wave length range with a 32 turn secondary in series was 160 to 410 meters. The inductance of the variometer alone ranges from 134.5 microhenries to 887 microhenries.

Arrived in good packing with no instruction sheet enclosed.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 53.

FROST JACKS

These jacks, five in number, are provided in the usual combinations of open circuit, single and double contact and filament control spring systems. They are manufactured by H. H. Frost, 154 West lake Street, Chicago, Ill. All metal parts,



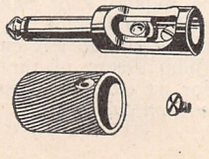
except the springs, are nickel-plated and polished. By the use of spacers they may be mounted on any desired thickness of panel from 1/16" to ¼". The lugs are fanned to facilitate soldering of connections. Fibre insulation is used to separate the springs. Arrived in good packing, enclosed in individual cartons.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 43.

FROST PLUG NO. 132

This plug is intended for use with telephones equipped with flat tips. It is manufactured by H. H. Frost, 154 West Lake Street, Chicago, Ill. The shell is fibre with a knurl on the outside to provide a better grip. Insulation is fibre throughout. Exposed metal parts are polished, while at the end it has been nickel-plated. Arrived in good packing enclosed in individual cartons.

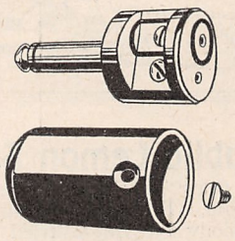
AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 42.



FROST PLUG NO. 137

The usual torpedo shape is incorporated in the frost plug, made by H. H. Frost, 154 West Lake Street, Chicago, Ill. It is intended only for telephones equipped with cord tips, for the fastening of which two holes are provided with small machine screws for clamping. The shell is of polished fibre and the metal plug is of polished brass. Insulation is fibre throughout. Arrived in good packing, enclosed in an individual carton.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 41.



C-H VERNIER RHEOSTAT

This vernier rheostat is made by the Cutler-Hammer Co., of Milwaukee, Wis. It is identical in construction with the plain rheostat, with the exception of the vernier feature. This consists of a grooved circular form on which a single turn of resistance wire is wound. This wire is placed in series with the main resistance element and is actuated by an auxiliary shaft through the main one. The knob on this shaft is shaped so as to conform with the lines of the main knob.

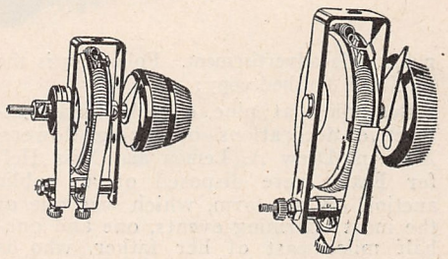
Tested 3 hours at 1.5 amperes. Resistance 4.3 ohms.

Arrived in good packing with instructions printed on the individual carton.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 55.

C-H V. T. RHEOSTAT

Instead of the usual system of an arm traveling over the resistance winding, in this rheostat, the resistance element rotates while the contact blade remains stationary. The rheostat is manufactured by the Cutler-Hammer Co., of Milwau-



kee, Wisconsin. A U-shaped frame supports the circular element on which the resistance wire is placed. The wire is wound helically and then stretched over a grooved form. Through this frame runs the shaft with its thermoplax knob and nickeled pointer. The circular element carrying the resistance wire is clamped to the shaft with a set screw so that when the shaft is turned the resistance wire moves gradually under the spring strip which forms the contact arm. Thus the resistance is changed by small steps from zero to 4 ohms.

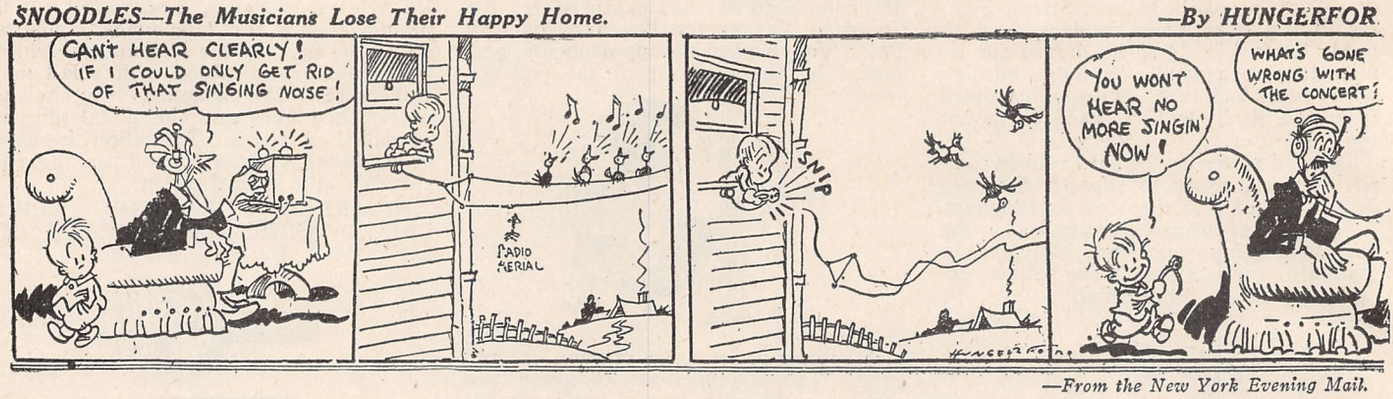
A template is furnished for locating the holes necessary to mount the rheostat on panels from ⅛" to ½" in thickness. Two flathead iron screws are also provided. All metal parts are nickeled.

Tested for three hours at 1.5 amperes.

(*Continued on page* 1559)

Radio Humor

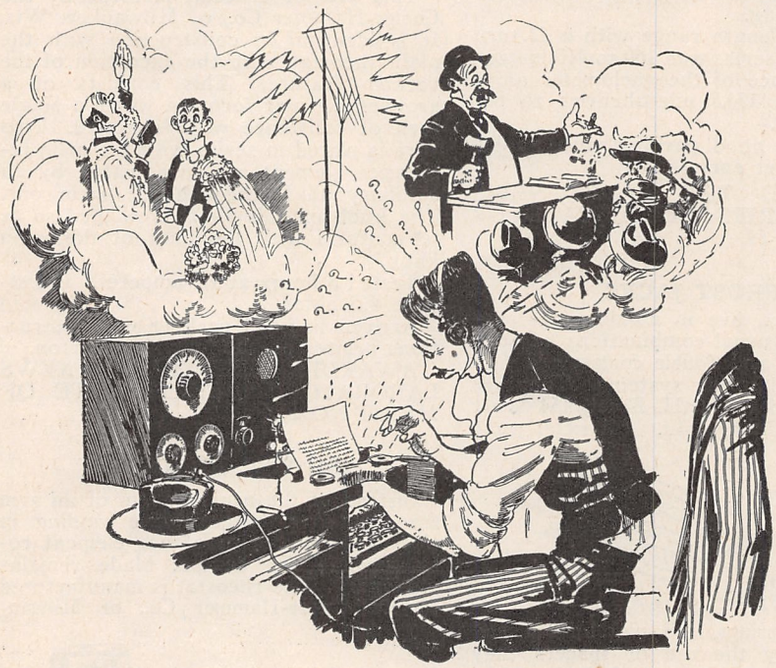
SNOODLES—The Musicians Lose Their Happy Home. —By HUNGERFOR



—From the New York Evening Mail.

Public Lemon Sale

ONE thing at a time is well, even in radio. Recently a reporter on the Floodwood *Bugle* tried to receive news messages from two country correspondents at the same time. One was broadcasting news of a wedding; the other a public sale advertisement. Following is the receiver's finished copy:



This Reporter Tried to Receive News Messages from Two Country Correspondents at the Same Time. Result: Another Good Man Gone Wrong. Moral: One at a Time, Gentlemen.

Beginning at nine o'clock amidst attractive decorations of spring flowers, Mr. Ann-Drew A. Lemon and Miss Helfer Eatin were disposed of at public auction on my farm, which was one of the most charming events, one and one-half miles east of her father, who is located at a vantage point, near the Logan-Nelsonville pike.

The bride was gowned in a becoming tarpaulin 10 feet by 16 feet, with large oval shaped mounds of good baled straw and the following property to wit: One Jersey bull, two years old, led the procession down the aisle and scattered other articles too numerous to mention before a background of farm implements and cathedral candles of pink. The impressive ring ceremony was said by six Poland-China pigs, registered and tubercular tested, pastor of the First Baptist Church of Floodwood. One set of single buggy harness with drop effect of trailing arbutus and her bridesmaid, complete with tugs and bridle, made it one of the most complete and charming events of its kind that will work single or double of the season. The groom was handsome in seven tons of clover and alfalfa mixed hay and diamond studded drag harrow with forty-two teeth. His best man was one DeLaine ewe, a former schoolmate at Ohio University.

Only intimate friends of sixteen milch cows were present, including fourteen registered Holsteins, the father and mother of the groom, six mules, and one good road scraper. Many beautiful and useful household articles such as sixteen quarts of tomato preserves, one brass kettle, beautiful cut glass, tin cans of all kinds, one churn, one baby crib, one electric toaster and six bushels of eating potatoes were received by the beautiful and charming auctioneer, A M. Mooney. The decorations of also one six-cylinder uncle and two white calves will be served on the grounds by the members of the Ladies Aid of the Floodwood church. The wedding took place at high noon and will last until all goods are sold. Terms—nine months' time with approved security as is the custom at sales of this kind, with interest at six o'clock dinner at the Ambrose Hotel, Logan.

After the nuptial knot had been tied with 200 feet of hay rope, the happy couple left on one good John Deers manure spreader, for an extended trip

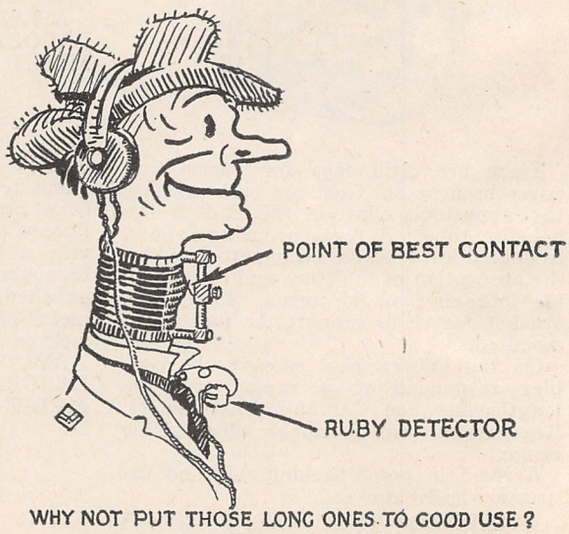
(*Continued on page* 1562)

The Regenerative Receiver

A most efficient set may be made up as follows: Place a quantity of case-hardened macaroni in a Wheatstone bridge and measure the specific inductive capacity. The result will give you the correct amount of inductance and the correct voltage of the "B" Battery for the tube employed. Tubes vary, of course. So will the result. The tubes I have were bought after 12 o'clock at night, and the people who owned them are still advertising in the up-state papers "and no questions asked." Wrap 14 turns of hard drawn Liztendraht about the perimeter of a hard boiled egg, carefully fastening the ends of the wire with a cement made up as follows: 2 lbs. ipecac (syrup-asbitteras thedickensus) and 12 oz. cold pressed alligator pears, to which is added three pounds of cut nails, thinning down the solution to a consistency of fireclay. This will give the proper amount of inductance to pick up the broadcasting schedule of the great doughnut foundry at Manunka Chunk, N. J.

For the tickler, procure a feather from the left wing of a whiffenpoof. See that it is free from sciatica. These are the best, and laboratory tests have shown that they have a coupling factor of 38 centigrade in low altitudes, but deteriorate rapidly if exposed to the fumes of ham and eggs in an air-tight vessel.

The variable condenser previously obtained from the local plumbing shop is placed in juxtaposition to the gas pipe supplying the soft detector. Before attaching the phones and the batteries, it would be better, if expecting to hear signals, for the experimenter to go out and fall down a manhole into the subway. He will be just as happy in the end.



WHY NOT PUT THOSE LONG ONES TO GOOD USE?

—Suggested by J. Bront.

RADIO CLUB OF AMERICA

At the last meeting of the Radio Club of America, held at Columbia University on Friday, December 1, Mr. S. E. Anderson, radio engineer, read a paper on vacuum tube amplification. This paper was of the utmost interest to all, as it covered both radio and audio frequency amplification. Mr. Anderson pointed out several features which are necessary in order to get the best results from an amplifier.

One of the most interesting topics was a discussion of the transformer and choke coil type, which was discussed at length and from which many derived beneficial knowledge.

All communications should be addressed to the Corresponding Secretary, 380 Riverside Drive, New York City.

THE MADISON HOUSE RADIO CLUB

The Madison House Radio Club was organized October 25, 1922. Meetings are held every Wednesday evening at 8 P. M. at the Madison House. Mr. Peck (2HC) of the Peck Radio Corporation, Brooklyn, directs the club, David Bailin has been elected President, Jacob Alper, Secretary. Max Halpern, Treasurer.

This club will be glad to receive correspondence from other clubs. At present we have a receiving set consisting of a fixed coupler, two variable condensers, detector and two stages of audio frequency amplification. Code practice has begun.

Address all correspondence to the Madison House Radio Club c/o Madison House, 216 Madison St., New York City, N. Y.

CHICAGO AMATEUR RADIO CLUB

The Chicago Amateur Radio Club, organized October 18, 1922, is campaigning to increase interest and popularity of radio among the West Side amateurs.

The officers recently elected are: Mr. Hyman Millstein, President; Mr. Jacob Applebaum, Vice-President; Mr. Benjamin Meyer, Secretary and Treasurer; Mr. Joe Bonner, Instructor. This club, at present, has 12 members. All correspondence with other radio clubs will be welcomed. Address Benjamin Meyer, Secretary, 1215 South Millard Avenue, Chicago, Ill.

FORMATION OF SEVENTH DISTRICT EXECUTIVE RADIO COUNCIL

During the first annual convention of the amateur radio operators of the seventh radio district, a resolution was adopted providing for the creation of an executive radio council for that district.

Due to the fact that at that time (June) there was not a sufficient number in attendance to hold an election, a temporary chairman (H. S. Jones) was appointed. He was given instructions to call a meeting at some date in the fall, and with this view in mind a circular letter has been sent to all the district amateurs. The letter is self-explanatory and says in part:

"It is desired to obtain as large an attendance as possible at this meeting in order to make the selection and election as representative of the district as practicable, as the Executive Council will have full charge of all matters pertaining to Amateur Radio activities in this district.

"A great many amateurs are so situated that they are not members of any radio club so that this letter is being sent to each station individually. Those of you who can get together, call a meeting locally and discuss the matter in full, and those who cannot attend a local meeting try to decide on some place that is centrally located to all of the district that you can get to when the Executive meeting is called. The place receiving the greatest number of votes will be the place selected.

"A postal is enclosed which you are requested to fill in and return at the earliest moment possible. On this card place your first, second, and third choice for the meeting place and the time which would be best suited for you to attend this meeting. Also state at which meeting place you could personally attend and if you cannot be present, to whom you would give your vote.

"In this connection it is desired to impress on each and every amateur that his support is essential to this organization and that he must put all the EMF that he has behind the movement in order to get plenty of amperes into the antenna.

"Signed by Temporary Chairman."

Roy A. Anderson,
P. O. Box 206,
Ketchikan, Alaska.

AMATEUR RADIO CLUB OF THE PHILIPPINES

Radio in the Islands is still in its very infancy. There are at most in the city and vicinity only about a hundred amateurs. Nevertheless, these amateurs are very enthusiastic and in order to promote further the Radio Art in this Archipelago, and for mutual benefit and protection, they have grouped together and formed the first real Radio Club in the Philippine Islands, naming it the Amateur Radio Club of the Philippines.

There is at present a single broadcasting station here, doing regular broadcast work, and that is WYAZ, at Camp Nichols, a town a few miles from Manila. The programs given on Monday, Wednesday and Friday nights 8:30 to 9:30 include musical selections, latest cable news, weather reports, time signals, lectures and sometimes short talks on Radio. But the music we are getting is still "canned" music and we, the amateurs, are hungering for real music. The Electrical Supply of this city, promises to do a regular broadcasting job in a few days more.

Coming back to the Radio Club I mentioned a while ago, I am proud to tell you that each and every member of the club is a real hard-working amateur; all are taking a deep interest for the betterment and dissemination of wireless. There are at present over fifty resident members and a few associate members. We have three honorary members, namely, Mr. Jose Topacio, Director of Posts; 1st Lieutenant Edward H. Guildford, U. S. Signal Corps and Mr. Carson Taylor, publisher of the Manila Daily Bulletin, the only paper here showing interest in Radio. Our officers are: Mr. Thomas L. Rivera, as President; Mr. William Ellis, Jr., as Vice-President; Mr. Eliodoro Claro, as Treasurer, and the writer as Secretary.

The Club expects to accomplish a number of important activities, chief among which is the installation and operation of a broadcasting staton for the benefit of the members. We have a receiving set constructed entirely by members.

JOSE E. JIMENEZ, Secretary.

NEW AMATEUR STATIONS

2 XAQ—J. C. Smith, 3 Corona Avenue, Valley Stream, N. Y.
2 XAR—D. W. May, Inc., 325 Central Avenue, Newark, N. J.
2 XL—Tarrytown Radio Research Laboratory, Tarrytown, N. Y.
4XK—Winter Park Electrical Construction Co., Winter Park, Fla.
4 XL—Mercer University, Macon, Georgia.
5 XADA—John O. Newbury, 1822 Bennett Avenue, Dallas, Texas.
5 XAEA—Radio Phone Sales Company, Enid, Oklahoma.
5 XAJ—C. B. Baxter, 204 Grafton Street, Dublin, Texas.
6 XAH—Archie Wade, Jr., 465 North Lake Street, Los Angeles, Cal.
6 XAV—W. W. Lindsay, Jr., P. O. Box 643, Reedley, Cal.
6 XAX—G. S. Corpe, 517 West Main Street, El Monte, Cal.
6 XAY—C. R. Tinsley, 3017 Wheeler Street, Berkeley, Cal.
6 XN—Dr. Alfred E. Banks, Timken Building, San Diego, Cal.
6 XW—Hall Berringer, 637 South Hope Street, Los Angeles, Cal.
6 XZ—R. O. Shelton, M. D., San Diego, Cal.
6 YC—University of Redlands, Redlands, Cal.
6 ZH—Lester Picker, San Ysidro, Cal.
6 ZY—Thomas A. Marshall, 242-D Kaiulani Avenue, Honolulu, Hawaii.
7 XM—Great Falls Power Co., Butte, Montana.
7 XN—Thompson Falls Power Company, Thompson Falls, Montana.
7 XO—Great Falls Power Company, Rainbow, Montana.
7 YQ—Enumclaw High School, Enumclaw, Washington.
7 ZF—F. F. Gray, 3200 Richardson Street, Butte, Montana.
8 XAM—Arthur L. Kent, 199 Court Street, Binghamton, New York.
8 XP—General Electric Co., White Sulphur Springs, W. Va.
8 YL—East End Y. M. C. A., Cleveland, Ohio.
8 YP—Seneca Vocation School, Buffalo, N. Y.
8 ZU—Radio Club of Mansfield, 139½ Carpenter Road, Mansfield, O.
9 XQ—Quincy Electric Supply Co., 10 Maine Street, Quincy, Ill.
9 XR—Colin B. Kennedy Co., 6400 Plymouth Avenue, St. Louis, Mo.
9 YAR—Lawrence College, Department of Physics, Appleton, Wis.

New Radio Legislation Is Needed

By CARL H. BUTMAN

THE extension of the regulatory powers of the Department of Commerce over radio is imperative, Secretary Hoover, who has become a sort of foster-father to radio, states in his annual report. Otherwise the development of radio art will be greatly retarded, he explains. The sudden increase of radio telephone broadcasting during the last seven months of the fiscal year from five to 382 transmitting stations, and the increase from about 200,000 to 1,500,000 receiving stations, resulted in so much "interference" between sending stations, the Secretary of Commerce reports, that the destruction of the usefulness of this very important invention was threatened. A conference of experts, manufacturers, and government, public and amateur representatives, which was called by Mr. Hoover in February, unanimously recommended the immediate extension of the regulatory powers of the government and drafted a set of technical provisions for submission to Congress.

Identical radio bills were introduced in the two houses of Congress last session by Senator Kellogg and Representative White, but they are apparently "pigeon-holed," awaiting, perhaps, the demand of the radio public itself before any action will be taken. Department of Commerce officials handling radio matters have cherished the hope that early action would be forthcoming for some time and continued to license all broadcasters every three months, while awaiting a definite law. New legislation would aid the Secretary of Commerce in enforcing the laws and bring about a more satisfactory condition for both operators and "fans," they point out. Authority for the appointment of the advisory committee of six Governmental and six outside civilian members, would assist the Secretary in reassigning definite wave-lengths and in the allotment of more bands for commercial and private uses. Congressman White's bill is expected to be pushed, but action is not assured this session.

DISCRETIONARY ASSIGNMENT OF WAVES HOPED FOR

Recommendations of the Radio Conference were for one exclusive Governmental broadcasting wave band, two bands for private and toll broadcasting, and four for use by both Government and private broadcasters, which would give such transmitting stations broader scope and prevent interference to a great degree. Today only two

(*Continued on page* 1530)

Free Medical Radio Service for Ships at Sea

THE United Fruit Company announces the inauguration of a free medical radio service from its hospitals in the various countries of Central America and from its passenger steamships to all ships at sea. So far as the United Fruit Company and its subsidiary companies are concerned, this service is available without charge to ships of all nationalities through the following radio stations operated by the United Fruit Company or the Tropical Radio Telegraph Company:

RADIO STATIONS AND THEIR CALL LETTERS

New Orleans, Louisiana.....WNU
Burwood, Louisiana.....WBW
Fort Morgan, Alabama.....WIO
Swan Island, Caribbean Sea.....US
Tela, Honduras .....UC
Puerto Castilla, Honduras.....UA
Tegucigalpa, Honduras (Open Nov.. 1922) .....UG
Port Limon, Costa Rica.....UX
Almirante, Panama.....UB
Santa Marta, Colombia .....UJ

All passenger steamships of the United Fruit Company.

For ship's call letters see International Radio Call Letter List.

Radiograms requesting medical advice should be signed by the captain of the ship and should state briefly, but clearly, the symptoms of the person afflicted. Such radiograms should be addressed "UNIFRUITCO" (name of place) and may be sent to any of the United Fruit Company's hospitals listed below:

Santa Marta, Colombia.
Port Limon, Costa Rica
Almirante, Panama
Tela, Honduras
Puerto Castilla, Honduras
Puerto Barrios, Guatemala

All United Fruit Company passenger steamships carry doctors, and free medical service may be secured by radio from any of them by a radiogram addressed "Ship's Doctor" followed by the name of the steamship.

This free medical service is established primarily for the benefit of ships not carrying doctors; however, should occasion require, ship's doctors may hold consultation by radio with the United Fruit Company ships' doctors and hospital staffs.

The physicians and surgeons comprising the medical staff of the United Fruit Company and its subsidiaries are thoroughly qualified, but in view of the fact that radio medical advice to ships at sea is given free and without an opportunity for a personal examination of the patients by them, no responsibility will be assumed by either the company and its subsidiaries or the physicans or surgeons giving the advice as to its accuracy or for error in the receipt or transmission of any message sent or received in connection therewith.

It is requested that when sending medical advice radiograms, radio operators check them "(number of words) DH Medico."

"DH Medico" radiograms will be given preference over all other radiograms, excepting SOS calls, throughout the radio service of the United Fruit Company and subsidiary companies.

A Few Suggestions

By J. E. HARA

MR. LEVIN'S recent plea for support of the defunct URTA is not without its grain of wisdom. One need only take the status of the Operator on the Great Lakes, where there is no Association, and compare it to that of the man on the coast, where there was an Association. A radio man on the Lakes is classed and paid the same as an ablebodied seaman. This is sufficient to warrant Mr. Levin's argument that there is power in unity.

However, I find that I do not entirely agree with him in his prediction that Operators will soon find themselves in the foc'stle. They have proved themselves too indispensable to modern navigation for such a reduction. I was recently one of a trio of operators aboard a certain trans-atlantic liner, which became fog-bound a day and a half from New York. By means of frequent Radio-bearings and advices of various ship's positions in our locality we enabled the Captain to make Nantucket Light with only a slight delay. Such service is appreciated and rewarded.

Nevertheless an Association, with intelligent direction at its head would be extremely beneficial to the game. Radio is not yet what it should be. I would like to make the following suggestions for consideration when the new Association, or rather old one, takes its work up again.

Radio operators are underpaid. Let it be the purpose of Association heads to bring it to what it should be. It is possible to bring this about by common sense conference with executive heads of the various steamship lines, not by strikes. Strikes tend only to force a temporary remedy, and in all are embittering. At the present time a radio operator can just eke out an existence on his emolument.

With the compensation raised Radio will be a better game, peopled by capable operators, content with their positions. Very few, yea nary a one, of the men I have questioned contemplates remaining at the key. John Jones is only at it because of the present business depression, but as soon as there is an opening in that broker's office the Radio profession loses a good man. And operator West intends to get his rich Uncle's legacy soon, he is only hanging on till the old man says 'nough, while Jimmie Johnson is out at sea so that he will have time to study and prepare for a degree on the Laws that govern goldfish. A thousand cases could be quoted, not one man intending to stay in the game. If it were worth their while things would be different.

Also, it should be a salient point in the URTA'S program to get better receiving equipment aboard some of the boats,—boats that are still using crystal detectors. Do modern business houses not employ adding machines, which are more rapid, more reliable than slow mental arithmetic? Then why not the audion for vessels? Is it not more efficient, better, than the carborundum?

English Weather Reports

THE Wireless weather bulletins hitherto broadcasted twice daily by Clifden (MFT) have been discontinued by that station.

The two undermentioned stations are temporarily carrying on the issue of these broadcasts.

(1) MALIN HEAD—(55.22N 7.20W)—GMH. 600 meters at 0900 and 2100 G. M. T.

(2) LAND'S END—(50.07N 5.40W)—GLD. 600 meters at 0915 and 2115 G. M. T.

The observations contained in these messages are taken at 0700 GMT and 1800 GMT respectively, and the message is composed of two parts, namely:

Part 1 Statement of general meteorological situation and forecast for 24 hours for the Western Seaboard of the British Isles.

Part 2 is in code and refers to the following stations:

Stornoway	58.11N	06.22W
Blacksod Pt.	54.06N	10.04W
Holyhead	53.18N	04.39W
Scilly	49.58N	06.18W
Dungess	50.55N	00.58E

Each group of figures represents the above named stations in the order given, the sixth group gives further information for all five stations.

First Group, Second Group, Third Group, Fourth Group and Fifth Group are composed of figures having the following significance.

1st, 2nd figures = corrected barometer in millibars to the nearest whole millibar, the first 9 or 10 being omitted.

3rd figure = True direction of the wind to nearest point. (See Table 1.)

4th figure = Wind force by Beaufort's scale, 9 representing forces of 9 and above.

5th figure = Visibility by scale (see Table 2).

In the sixth group each figure represents the barometric tendency (see Table 3) for the stations in the order named.

In the case of missing observations a hyphen is inserted in the place of each missing figure.

TABLE 1.—WIND DIRECTION (TRUE)

0 = Calm	5 = S. W.
1 = N. E.	6 = W.
2 = E.	7 = N. W.
3 = S. E.	8 = N.
4 = S.	

TABLE 2.—VISIBILITY. (SEA)

0 = Dense fog.	50 yards.
1 = Thick fog.	1 cable.
2 = Fog.	2 cables.

(*Continued on page* 1544)

THIS Department is conducted for the benefit of our Radio Experimenter. We shall be glad to answer here questions for the benefit of all, but we can publish only such matter as is of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent.
2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.
3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.
4. Our Editors will be glad to answer any letter, at the rate of 25c for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

You will do the Editor a personal favor if you will make your letter as brief as possible.

THREE COIL H. C. HOOK-UP

(590) Mr. Alfred F. Seils, Rochester, New York, writes:

Q. 1. Please publish the best three-coil honeycomb hook-up with two steps of amplification. Give full description of all parts, also capacities of all condensers.

A. 1. This hook-up was published in our January issue question number 272. Only one stage is shown but any number of stages can be added, in the same way. The size of honeycomb coils used depends entirely upon the wave-length range to be covered. Use a .00025 M. F. grid condenser, .001 M. F. variable condenser for secondary and series variable condenser, .00025 M. F. fixed condenser across the phones and "B" battery.

Q. 2. Give number of coils for each set up to 25,000 meters.

A. 2. For the number of the coils for each set up to 25,000 meters, we refer you to the tables printed in the de Forest catalog.

Q. 3. What capacity storage battery would be required for this set Also for "B" batteries?

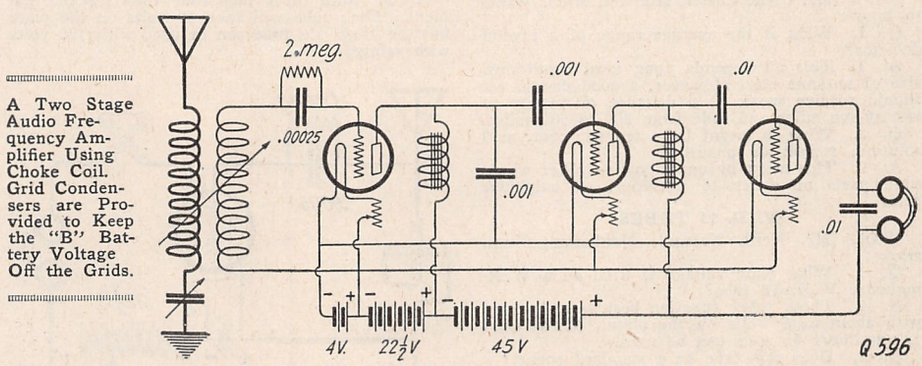
A. 3. A 6-volt, 80-ampere storage battery for heating the tube filaments. 22½-volt "B" battery will be required for the detector tube and approximately 45 volts for the amplifier tubes.

THREE STAGE AMPLIFIER

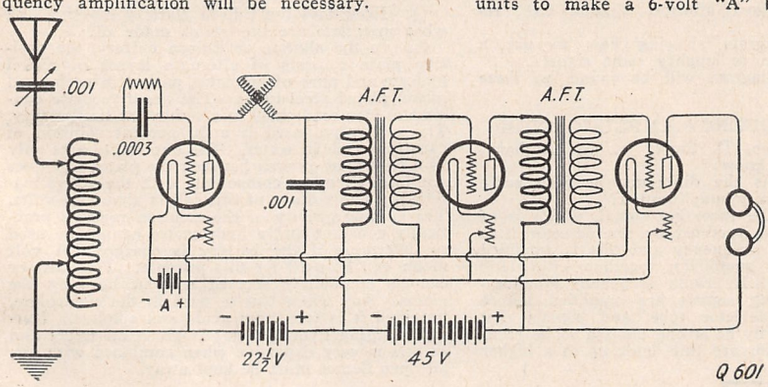
(591) Mr. Harvey G. Adams, Salem, North Carolina, wants to know:

Q. 1. Will you kindly publish a diagram of a three-stage amplifier with honeycomb coils that will reach the distance from Chile, South America, to Pittsburgh, Pa.?

A. 1. The circuit you desire will be found in the December issue, question No. 532. For the distance you mention several stages of radio frequency amplification will be necessary.



A Two Stage Audio Frequency Amplifier Using Choke Coil. Grid Condensers are Provided to Keep the "B" Battery Voltage Off the Grids.



A Single Circuit Tuned Plate Regenerative Receiver With Two Stages of Audio Frequency Amplification.

Q. 2. Please publish diagram showing how to change this circuit from honeycomb coils to variometer?

A. 2. The circuit you desire was printed in the "I-Want-To-Know" column of the September Radio News under number 441.

R. F. SWITCHING ARRANGEMENT

(592) Mr. G. H. Gardner, Unionville, Ohio, asks:

Q. 1. In the October issue, page 661, "I-Want-To-Know" column, you show hook-up for a switching arrangement to use one or two stages of radio frequency amplification. I would like to see this carried out for three stages. I cannot figure out how to use the second switch as shown in cutting out the second stage. How do you connect the secondary of the first transformer to the grid of the detector tube with switch as shown?

A. 1. In reference to this circuit, the following method is carried out. For two stages of radio frequency amplification and detector, switch No. 1 is closed and switches two and three are placed in the down position. For one stage of radio and detector, switch No. 1 is opened, switch No. 2 is placed in the up position, switch No. 3 is in the down position. In this case, only the second stage and detector are being used. Switches No. 1 and No. 2 are left open and switch No. 3 is placed in up position for detector use only. The third stage may be connected by the same means, i.e., by the use of a two point switch as designated in the second stage. The control of successive stages of radio frequency amplification lies in the proper combination of switch positions.

PHONE REPAIRING

(593) Mr. Perrins Brenensteel of New London, Ohio, asks:

Q. 1. Will you give the address of some firm who will repair a headset as mine does not work?

A. 1. Send your phones to the company who manufactures them. They are best equipped to repair them.

(594) Mr. G. D. Booth of Natchez, Miss., wants to know:

Q. 1. Can I use three 2-volt "B" battery units to make a 6-volt "A" battery?

A. 1. This may be done but due to the low capacity of the cells, they will not last for any length of time, and frequent recharging would be necessary.

DETECTOR TUBE AS TRANSMITTER

(595) Mr. Kenneth G. Price of New Bedford, Massachusetts, asks:

Q. 1. Is it possible to use a Radiotron receiving tube for phone transmission in the hook-up found in Q. 367, page 1119 of the June issue of Radio News.

A. 1. A Radiotron receiving tube will not stand a very high voltage. It is by far the best means to use a Radiotron U. V. 201 or U. V. 202.

Q. 2. Can I take my high voltage from the secondary of a Ford coil

A. 2. Yes. You may use a Ford coil for stepping up the voltage, using 4 volts on the primary and a large condenser across the Secondary.

MYERS TUBES AND COKES

(596) Mr. Lucian Leape, Covington, Va., writes:

Q. 1. Give hook-up using Myers tubes with chokes for A.F. Amplification.

A. 1. Hook-up will be found on these pages.

Q. 2. Can these tubes be used for R.F. Amplification in connection with chokes?

A. 2. Yes, these tubes can be used for R.F. Amplification if used with the proper choke coils.

THREE CIRCUIT TUNING

(597) Mr. P. Turner, Norton, Va., wants to know:

Q. 1. How to tune a three circuit tuner?

A. 1. The grid and plate variometers are set at zero. The primary of variocoupler is tuned to incoming signal. The grid variometer is now turned till signals are loudest. This tunes the secondary or grid circuit. The plate variometer is now varied and the signals will again increase due to regeneration. A place will be reached where the tube begins to oscillate. This is indicated by a click in the phones and the signals will become distorted. Just below this point is the desired position. It will be found easier to tune the plate and grid circuits at the same time. If interference is experienced the coupling should be loosened and the set retuned.

Q. 2. Can a bank wound coupler be used in this set?

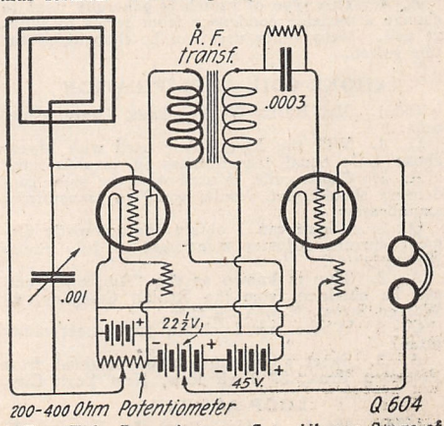
A. 2. Yes. But as the rotor has not the necessary inductance the efficiency will be lowered on the higher waves. The secondary can be shunted by a .001 variable condenser to increase the wave length of the secondary circuit.

PREPARINGG STORAGE BATTERY PLATES

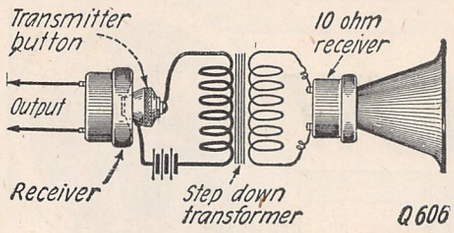
(598). Mr. N. J. Tawes, Laurel, Del., asks:

Q. 1. How is the paste prepared for storage battery plates?

A. 1. A pasted plate is usually made by applying to a hard lead-antimony grid, a paste made of some oxide of lead, usually litharge, (PbO) or red lead (Pb_3O_4) and some liquid and other substance such as anthrocine, glycerine, graphite, potassium silicate, etc., to increase the hardness, porosity, toughness and conductivity. After the grid is filled with the paste the plate is dried. After being completely dried a number of plates are assembled in a forming bath of dilute sulphuric acid with dummy lead plates for the opposite electrode and a forming charge is given by passing the proper current through the voltaic couple thus formed. Positive plates are formed by con-



A Two Tube Loop Antenna Set with one Stage of Radio Frequency Amplification. Variation of Wavelengths is Accomplished by the Variable Condenser.



Simple Loudspeaker Using a Skindervicken Button Coupled to a 10 Ohm Receiver Through a Step Down Transformer.

necting the plates to be formed as the anode; the current further oxidizing the lead oxide to lead peroxide (PbO_2). Negative plates are formed by passing the current in the opposite direction, reducing the lead oxide to sponge lead.

RANGE OF CRYSTAL DETECTOR

(599). Mr. Clyde Coster, Holland, Mich., wants to know:

Q. 1. What is the average range of a crystal detector?

A. 1. This all depends upon local conditions, size of antenna etc. However, a good crystal set should receive music at a distance of twenty to twenty-five miles and code from 300 to 500 miles.

Q. 2. What is meant by a ten per cent. acid solution, weight or quantity?

A. 1. This mean by quantity. In other words nine parts of water to one part of sulphuric acid.

W. D. 11 TUBES

(600). Mr. Keith Norwell, Manhattan, Kan., asks:

Q. 1. What plate voltage is used on a Westinghouse W.D. 11 tube?

A. 1. These tubes function best as a detector with about 22½ volts on the plate. When used as amplifiers 45 volts can be used.

Q. 2. Does this tube fit a standard socket?

A. 2. No. An adapter must be used if this tube is to be used in a standard socket.

Q. 3. Are these tubes on the market?

A. 3. Yes, they can be now bought from any radio dealer.

TWO STEPS OF AUDIO FREQUENCY

(601). Charles J. Coward, South Byron, N. Y., writes:

Q. 1. Can the hook-up shown in question 439 of the September issue be used with two steps of audio frequency amplification?

A. 1. Yes. The hook-up is shown on these pages.

Q. 2. What extra parts are needed?

A. 2. Two sockets, two rheostats, two amplifying tubes, two audio frequency transformers and an extra 22½ volt battery.

Q. 3. What amplifying transformers are best?

A. 3. Any standard transformer with a 3 to 1 ratio will do.

RADIO VS. AUDIO FREQUENCY

(602). Dr. Lewis J. Freedman, New York City, wants to know:

Q. 1. Is radio frequency better than audio frequency?

A. 1. This all depends on what is desired. Audio frequency will amplify anything that is rectified by the detector so that a large volume of sound is had. Radio frequency amplifies the signals before they reach the detector, thus bringing in signal that would not otherwise be heard with the detector *and A. F. amplification* alone.

Q. 2. What length antenna is recommended?

A. 2. The best antenna is one wire about 100 feet long and above surrounding objects if possible.

Q. 3. What radius in miles should I receive?

A. 3. No answer can be given to this question. This depends upon the type of set used, skill of operator, local conditions, etc.

Q. 4. Is a series parallel switch important and why?

A. 4. This type of switch is generally used to change a variable condenser from series to shunt at will. Many other uses can be thought of for this switch.

CHOKE COIL AMPLIFICATION

(603). Mr. Rufus W. Feitshaus, Laura, Ohio, asks:

Q. 1. Will the Myers type used with Myers choke coils equal transformers in amplification?

A. 1. Choke coils, if used with the right condensers should give results equal to transformer amplification.

Q. 2. Where can I obtain the automatic filament current adjuster mentioned in July RADIO NEWS?

A. 2. This is known as the "Amperite" and can be obtained from the Radiall Company, 99 Warren Street, New York City.

Q. 3. Where can I obtain pure sheet aluminum?

A. 3. Sheet aluminum can be obtained from Patterson Bros., 27 Park Row, New York City.

LOOP ANTENNA

(604). Mr. L. A. McClelland, Jr., Jamaica, N. Y., asks:

Q. 1. Show a hook-up of an all wave coupler with a loop and two tubes (det. and one step of audio frequency).

A. 1. A loop cannot be used in conjunction with this tuner efficiently and radio frequency must be used, as not enough energy is received with a loop for a detector alone. A loop, shunted by a .001 variable condenser is the antenna and tuner in itself.

Q. 2. Also show with detector and one stage of R. F. amplification.

A. 2. Diagram will be found on these pages.

Q. 3. Would like specifications of loop.

A. 3. Eight turns of No. 18 wire on a loop four feet square and *shunted by a variable condenser of* .001 *capacity will be satisfactory.*

VOLTAGES ON MYERS TUBES

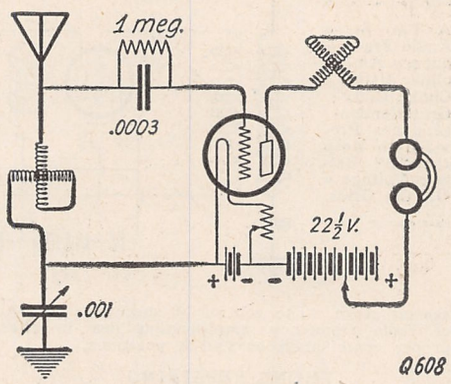
(605). Mr. Henry F. Stumberg, Vancouver, Wash., asks:

Q. 1. Can both types of the Myers tubes be used as detector or amplifier?

A. 1. Yes, but the 'Myers High Mu' tube will be better as an amplifier.

Q. 2. What is the filament and plate voltage of each tube?

A. 2. Both tubes take four volts for the filament. Each tube will take 60 volts on the plate but the High Mu tube can be used with 120 volts with safety.



A Variometer Tuned Plate Circuit Regenerative Receiver. This Type Is Easily Controlled.

Q. 3. Are the Myers Choke Coils used as, or with a transformer?

A. 3. These choke coils are used alone for amplification and a different coil is supplied for radio frequency amplification.

TRANSMITTER BUTTON AS AMPLIFIER

(606). Mr. Floyd Monroe, Vitalia, Cal., requests:

Q. 1. A diagram showing how to use a transmitter button to amplify radio signals.

A. 1. This diagram will be found on these pages.

RADIO FREQUENCY AMPLIFICATION

(607). Mr. Geo. D. Snell, Jr., St. Anthony, Idaho, wants to know:

Q. 1. What is the difference between radio and audio frequency amplification?

A. 1. When the incoming signal, which is of radio frequency is rectified by the detector it is changed to audio frequency and this is amplified by the following amplifiers, together with static and tube noises. By radio frequency amplification, the incoming signals are amplified before they reach the detector tube, and signals that would not ordinarily be strong enough to be rectified by the detector are thus built up to a higher potential.

TWO-VARIOMETER HOOK-UP

(608). Mr. Frank L. Roberts, New Bedford, Mass., wants to know:

Q. 1. Give a hook-up of two variometers and variable condenser.

A. 1. This hook-up will be found in these columns.

Q. 2. What are W. D. 11 tube?

A. 2. This tube is manufactured by the Westinghouse Elec. & Mfg. Co. and is designed to be used with a single dry cell for lighting the filament.

Q. 3. Can I get Medford Hillside with this set with an antenna 55 ft. long and 30 ft. high?

A. 3. You should have no difficulty in receiving this station. Your reception would be better if your antenna was increased to 100 ft.

INTERFERENCE

(609). Mr. James Rountree, Brooklyn, N. Y., encloses diagram of his set.

Q. 1. How can I tune sharper with this set?

A. 1. A variable condenser of .001 capacity in series with the ground lead would help. If two or more stations are sending on exactly the same wave it is of course impossible to tune one out.

HOOK-UP WITH W. D. 11 TUBE

(610). Mr. Harley A. Tuttle, Funk, Ohio, requests:

Q. 1. Please show hook-up using the Westing house "peanut" tube.

A. 1. This tube can be used in any receiving circuit by using a single dry cell in place of a 6 volt storage battery.

R. F. AND A. F. WITH SAME TUBES

(611). Mr. H. B. O'Neill, Toronto, Ont., wants to know:

Q. 1. Please show hook-up of two stages of A. F. and two stages of R. F. using the same tubes.

A. 1. Hook-up is shown on these pages.

RE-RADIATION FROM A TUBE SET

(612). Mr. Lyle Mauss, Milford, Iowa, asks:

Q. 1. Do vacuum tube sets in the vicinity of a crystal set make the reception of music possible by the crystal set by re-radiating it?

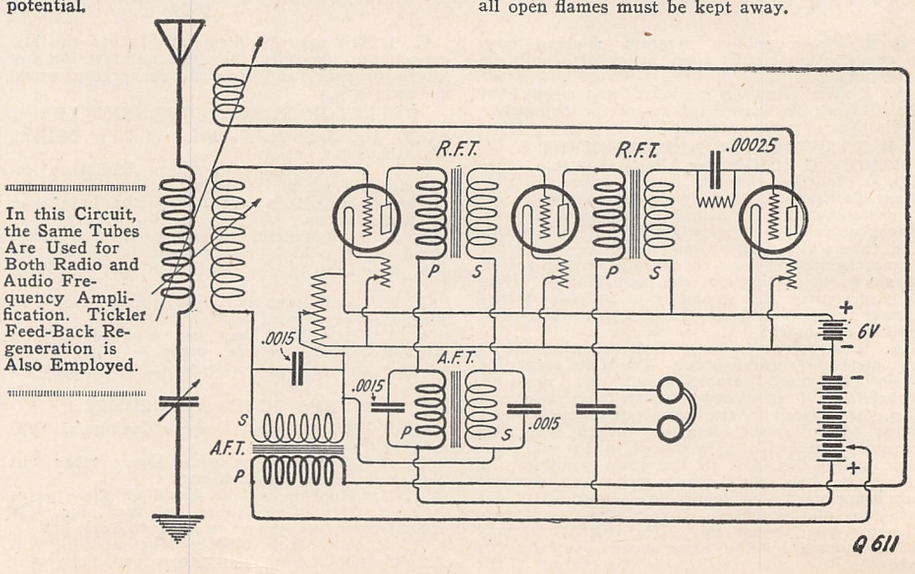
A. 1. Crystal sets have been known to receive signals that were ordinarily outside of their receiving radius, due to some tube set in the vicinity. If a tube set is tuned to the exact wave length of the distant phone station and is set in oscillation it will naturally radiate these oscillations. This acts as if an oscillator were used in conjunction with the crystal set, reducing the resistance of the circuit to zero, thus permitting the weak signals received to produce a sufficient response in the detector circuit. Enough energy being received in this manner, it is rectified by the crystal and actuates the phones.

ALKALINE BATTERY

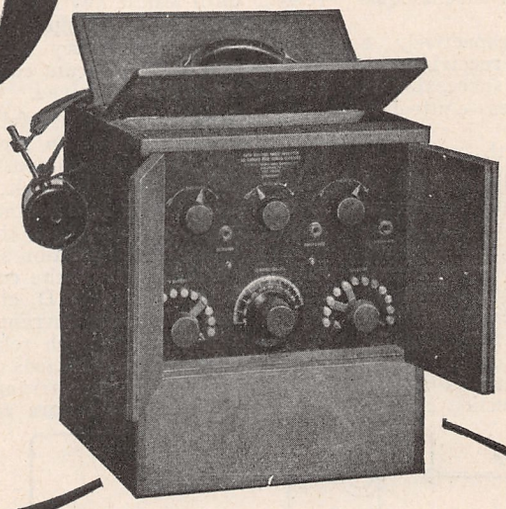
(613.) Mr. H. L. Ludin, Chicago, Ill., asks:

Q. How does the Edison Battery function and what materials are the plates made of?

A. In the alkiline or Edison battery, the positive plate consists of alternate layers of nickel hydrate and pure nickel flake, packed in perforated nickel plated steel tubes. The negative plate consists of iron oxide held in a somewhat similar way. The electrolyte used is a 20 percent solution of caustic potash in water. The electrolyte acts only as a carrier of oxygen between the plates and does not form chemical compounds with the active materials. The voltage of this cell is about 1.4 volts. The specific gravity of the solution remains practically constant and a hydrometer cannot be used to determine if the battery is charged. A volt meter can be used for this purpose. This battery can be completely shorted without harming the plates. Any water can be used in the electrolyte, provided it is free from acids and sulphur. During charging hydrogen gas is given off freely and as this is very explosive when combined with air, all open flames must be kept away.



5 minutes and an Oard Phantom TRADE MARK Receptor



-no aerial -no ground

In all radio no other set like the *Oard PHANTOM Receptor*—different in principle, different in construction, different in operation. So simple any one can operate it anywhere, at home, a-visiting, or a-traveling. So efficient it brings in broadcaster programs loud and clear from hundreds of miles around. So highly selective the operator can choose his own program and shut out interference. And all *without aerial or ground connection,* only a piece of ordinary lamp cord 20 to 50 feet long, concealed in the picture molding, or placed wherever most convenient. Ask the A-P dealer nearest you for demonstration, or write us for folder.

ATLANTIC-PACIFIC RADIO SUPPLIES COMPANY

646-50 Mission St., San Francisco, Calif.

Sole Agents of Oard Laboratories, Stockton, Calif.

Special Sale of odd size

CABINETS

Mahogany, Walnut, and figured Gum cabinets, f. o. b. San Francisco, at—

$2.75—$3.10—$4.25—$7.50

A-P Quality Line

Five minutes and the **Oard PHANTOM Receptor** is ready for a radio frolic any time, at home or away. Take it calling. Take it driving. Take it hunting. Take it camping. "It's all inside." Just open up the rear compartment, uncoil the piece of lamp cord that takes the place of an aerial, and tune in on your favorite program. Under just such conditions, without any aerial or ground connection whatever, it is not at all difficult or uncommon to receive stations from 500 to 1,000 miles distant. Every day we get reports of results like this from enthusiastic owners of this marvelous set. Why shouldn't you and your friends and your family enjoy an **Oard PHANTOM Receptor** too?

RADIO HEADQUARTERS

Play Safe—Buy Standard Equipment

Westinghouse RC Receiver	$132.50
Westinghouse Aeriola Sr. Receiver with Head phones and tube	65.00
Westinghouse AC Amplifier for Sr., two tubes	68.00
Grebe RORN Rad. Freq. Amplifier	60.00
Grebe CR-8 Receiver	80.00
Grebe RORK Amplifier	21.75
Monroe DA-7 two stage Receiver	75.00
Kennedy 281 Short Wave Receiver	90.00
Kennedy 521 Two Stage Amplifier	55.00
Kennedy 110 Universal Receiver	285.00

Tubes, Batteries, Phones, Extra except as noted

Tuska No. 201 Variometer	6.25
Tuska No. 231 Variocoupler	5.00
Tuska No. 232 Variocoupler	7.00
Atwater-Kent Variometer with Dial	9.00
Atwater-Kent Variocoupler	8.00
Workrite Variometer	3.50
Workrite Variocoupler	3.50
Remler Apparatus	Standard Prices
Murdock No. 324 Crystal Detector Stand	1.00
Signal No. 40 Silicon Detector Stand	1.35
Chelsea No. 3a .0011 mfd. Var. Condenser	4.25
Chelsea No. 5a .00025 mfd. Var. Condenser	3.35
Chelsea No. 6a .00008 mfd. Var. Condenser	2.50
Signal R 76 .001 mfd. Var. Condenser	4.50
Signal R-77 .0005 mfd. Var. Condenser	3.60
Signal R-78 .00025 mfd. Var. Condenser	3.00
R.C.A. Faradon Var. Condenser UC-1820	7.50
R.C.A. Faradon Var. Condenser UC-1819	8.75
Howard Plain Rheostat	1.10
Howard Vernier Rheostat	1.50
Howard Potentiometer	1.50
Cutler-Hammer H-2 Plain Rheostat	1.00
Cutler-Hammer H-1 Vernier Rheostat	1.50
Bradleystat	1.85
Murdock No. 560 Rheostat	1.00
Atwater-Kent AF. Amplifier Transformer	5.50
Jefferson 41 AF. Amplifier Transformer	4.25
Acme A-2 AF. Amplifier Transformer Semi-Mtd.	5.00
R.C.A. UV-712 AF. Amplifier Transformer	7.00
R.C.A. UV-1714 RF. Amplifier Transformer	6.50
Radion 3 in. Dial	.75
Radion 4 in. Dial	1.00
Federal and Frost Jack and plugs.	See our Catalog
Jasco Binding Post 5/16 x 3/4 in.	.08
Eby Remler & Read-em Posts	See our Catalog
Radiotron UV 200 or Cunningham C-300 Detector Tube	5.00
Radiotron UV 201 or Cunningham C-301 Amplifier Tube	6.50
Aeriotron WD-11 Dry Battery Tube	6.50
Jefferson No. 49 Socket	1.00
Remler No. 92 Socket	1.00
R.C.A. UR-542 Porcelain Socket	1.00
R.C.A. UP-552 Bakelite Socket	1.50
Murdock No. 550 or 552 Socket	1.00
Remler No. 96 Grid Leak	.40
R.C.A. Grid Leaks any size	.75
Remler No. 97 Grid Condenser	.20
Nathaniel Baldwin Phones	12.00
Nathaniel Baldwin Loud Speaker Unit	6.00
Brandes Superior Phones	8.00
Western Electric Phones	12.00
6 ft. Double Headphone Cord	1.00
Westinghouse Vocarola	20.00
Magnavox Radio R-3	45.00
Western Electric 10-D Loud Speaker	55.00
Cabinets	3.00 to 5.00
Bakelite and Ebony Asbestos Panels	.63 to 6.48
Westinghouse Complete Antenna	7.50
Screen Bezel for Tube Window	.20
Busbar Wire per foot	.03
Set of 12 Name Plates, Antenna, Ground, etc	1.00

Radak Sets, Tuska apparatus, lever switches, condensers, batteries, battery clips, Antenna wire, insulators, lightning arresters, magnet wire, books, meters, transmitting equipment, tools and supplies. See our Catalog

FREE CATALOG illustrated, sent on request.

Dealers—Buy reliable equipment from a house of established reputation. Send for our catalog of tested and approved apparatus and our discount sheet.

IN BUSINESS SINCE 1860

JULIUS ANDRAE & SONS CO.
117 MICHIGAN ST. MILWAUKEE, WIS.

Radio Control

(Continued from page 1460)

ism where "sequence of operation" was desirable, but it can easily be imagined that considerable confusion might arise if in order to independently control, say, three electric motors, it was necessary to do so in "sequence." For instance, it might be desirable to first control, say, motor No. 3, and afterwards motor No. 1, and so on. This would involve a system of "direct selection"; the transmitting apparatus being provided with keys corresponding to the number of mechanisms to be controlled.

Figs. 1 and 2 show, respectively, a scheme of transmitting and receiving circuits, which proved very successful in connection with my "wireless-controlled carillon."

No Aerial or Earth

In Fig. 8 is shown a modified form of "Hertz" oscillator with other apparatus for "direct selective control." As I explained in my first article, a modified "Hertz" oscillator is shown in order that experimental apparatus may conform to "official" regulations in cases where it is not intended to connect wireless apparatus to an "aerial" and "earth."

The transmitting apparatus as shown in Fig. 8 consists of an induction coil A, spark gap B with metallic rods N N (which represent an "aerial"), battery C (for circuit connected to primary winding of the induction coil A), contacts D and E (which are closed by means of the "short-circuiting" device M, which is attached to but insulated from the armature of the relay F), metallic drum G with contacts H and I, "common return" contact P, relays J1, J2 with armature, and contacts L1, L2, Morse keys K1, K2, also relay battery R B.

The receiving apparatus as shown in Fig. 9 consists of a coherer with base A, de-cohering device B B, with contact C, coherer battery C B, metallic rods H H (which represent an aerial), relay D with contacts E, relay F with contacts G and G1, also contact device V W (which is attached to but insulated from the armature Y; a dashpot, not shown, is attached to the relay F to retard the upward movement of the armature Y), relay battery R B, relay J with contact U, metallic drum X with contacts L, L1 and "common return" contact K, relays M, M1, with armatures and contacts R, T, relays N, N1, with contacts Q, R, small series wound motors O, P, battery for motors M B. The motors are shown merely as examples of mechanism or apparatus it might be desired to control.

In operation the metallic drums G and X (as shown in Figs. 8 and 9) are caused to revolve synchronously, so that, for example, contacts H (on drum G) and L (on drum X) are closed simultaneously. The apparatus for effecting synchronism of the metallic drums G and X is not shown.

By depressing Morse key K1 (as shown in Fig. 8) current will flow from the relay battery R B through relay J1, drum contact H, and "common return" P, through relay F, the latter attracting its armature will close contacts D and E, thus admitting current through the primary winding of induction coil A (the trembler of induction coil is not shown), causing a high potential discharge (from the secondary winding of the induction coil A) across the spark gap B, setting up oscillations which will continue so long as the Morse key K1 is depressed, as although drum G may revolve and break contact at H, the relay J1 will have attracted its armature and closed contact L1 through which current will flow to relay F until Morse key K1 is released.

The same cycle of operations would take place if Morse key K2 were depressed, except that drum contact I and relay J2 would be involved.

By referring to the receiving circuits and apparatus as shown in Fig. 9, it will be observed that simultaneously with depressing Morse key K1 (as shown in Fig. 1) and the coherer A detecting a transmitted wireless wave, and the metallic drum X being in the position shown, current will first flow from the coherer battery C B through relay D, closing contact E, and admitting current from the relay battery R B through relay F, closing contact G, and afterwards contact G1.

The latter contacts are arranged so that contact G is closed before contact G1,

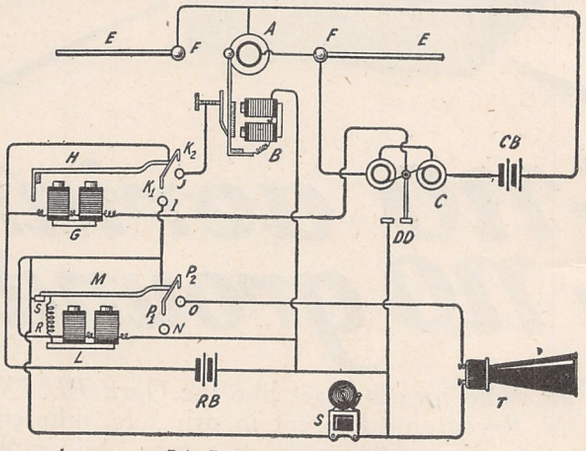


Fig. 11.—A Scheme of Circuits Suitable for "Time Period" Control. This is so Arranged that a Bell or Motor Horn May be Controlled at Will from a Transmitter.

and a dashpot (not shown) being fitted to the relay F causes a retardation of the "upward" movement of the armature which keeps contact G closed after current has passed from the relay battery R B through contact G1 and de-cohering device B B.

From contact G, current flows through relays N M through contact L, "common return" K, and contact U of relay J. Contacts Q and R will simultaneously be closed by the armatures of relays N and M admitting current through electromagnet windings of relay J, breaking contact U connected with "common return" K, cutting off communication with contacts L, L1, and admitting current from motor battery M B to motor (shown series wound) O1, although drum X may revolve, and contact at L be broken.

The motor O1 may be kept working so long as Morse key K1 (shown in Fig. 8) is kept depressed, and the secondary winding of induction coil A discharges a high potential discharge across spark gap B.

The motor marked P in Fig. 9 could be operated in the same manner, by depressing Morse key K2 as shown in Fig. 8. It will be observed that with a "fixed" wave length the scheme of circuits shown in Figs. 8 and 9 admits of numerous mechanisms being controlled.

I previously explained that in some instances (especially where consideration of weight of apparatus was involved) it might be desirable, and in fact necessary,

3000 Miles
with a one-bulb Radak set

Detroit, Sept. 30, 1922.

"I NOTICED an ad by your firm which stated that with your Type H. R. set, using no amplification, 'The Detroit News' had been heard from Denver, 1100 miles away. This seemed hardly possible, but I knew it must be true for you offered to send the name of the hearer on request.

"I immediately wanted one of your sets. I bought one, and there the fun began. It was in the latter part of July and the static was bad, but I heard the concerts wonderfully well. . . . .

"One night the third week in September, I had just finished listening in on about eight distant stations, including W. A. A. C., New Orleans and W. S. B., Atlanta, when far away I heard the sound of a human voice; as I tuned finer it came nearer and nearer, till at last I heard the speaker plainly. He gave a short talk on concerts and then said:

" 'This is K. G. F., the station of the Pomona Fixture and Wiring Co., *Pomona, Cal.* K. G. F. signing off.'

"There was no mistake, I heard the words plainly and also the call distinctly. Pomona, Cal. is about 3,000 miles from Detroit and it does not seem true that a one-bulb set, using *no amplification,* could get such a distance, but your wonderful little set did.

"But the 'wonder set' kept right on breaking records for distance, clearness, quality and everything else.

"Last Saturday, Sept. 30, I listened in on fourteen outside stations at night, ten of which were over 500 miles away and one 1100 miles distant. They are as follows:

"W.B.Z., Springfield, Mass.; K.D.K.A., Pittsburg, Pa.; W.N.A.S., Louisville, Ky.; W.E.A.B., Fort Dodge, Iowa; W.L.K., Indianapolis, Ind.; W.J.Z., Newark, N. J.; W.A.A.S., Atlanta, Ga.; W.S.B., Atlanta, Ga.; W.G.M., Atlanta, Ga.; W.G.I., Medford-Hillside, Mass.; W.B.A.G., Bridgeport, Pa.; W.O.H., Indianapolis, Ind.; K.L.Z., *Denver, Col.*

"All these with your Type H. R. set, *no amplification.* It doesn't seem possible."

(Signed) WM. A. ALLEN.

Radak

Reg. U. S. Pat. Off.

Reliable Radio Sets

Made by the

CLAPP-EASTHAM CO., 107 Main Street, Cambridge, Mass.

America's Oldest, Largest, Exclusive Mfrs. of Radio Equipment

LATEST CATALOG OF RADAK SETS
6 Cents Stamps

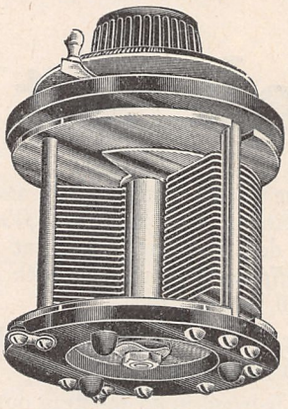
Shows the complete line of popular priced Radak Receiving and Amplifying Sets. Also Radak Parts and Accessories.

MODEL H R RADAK RECEIVING SET

Referred to in the above letter. Very easy to operate. Receives wave lengths of 180 to 825 meters. Licensed under Armstrong U. S. Patent 1113149.

COMBINATION VERNIER and VARIABLE CONDENSERS

43 and 23 Plate



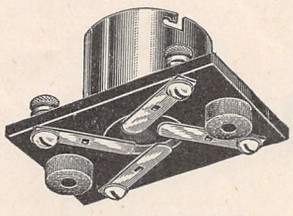
Built to give long Service

Construction

Metal end plates supported by best grade insulating material.
Rotor and Vernier supported by and turn in metal bearings.
Plates will always remain in true position.
All metal used is non-magnetic.
These models have been calibrated. The 43 plate has a ratio of 1-40 between minimum and maximum capacities. The vernier has a capacity effect equal to approximately three points on the dial.

List Prices

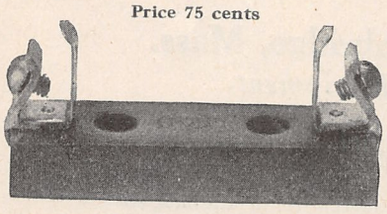
Vernier Panel type 43 plate Cap. .0012 M. F.	$6.75
Vernier Panel type 23 plate Cap. .00056 M. F.	6.25
Vernier Table type 43 plate with 3-in. bakelite dial	8.00
Vernier Table type 23 plate with 3-in. bakelite dial	7.50
Regular type Variable Condensers:	
43 plate	$4.50
23 "	4.00
11 "	3.50
3 " Vernier	3.00



P. M. T. Co. Tube Socket

Heavy insulation base. Polished nickel brass socket. Phosphor bronze silver plated contact points, so spaced as to eliminate possible capacity effect.

Price 75 cents



P. M. T. Co. Tubular Mounting

Heavy fibre base and phosphor bronze contact springs. Price.....50c

P. M. T. Co. Audio Frequency Transformer

gives the highest amplification possible without in any way causing noisy circuits. Very efficient and has superior electrical characteristics. Positively guaranteed.

Price $4.50

Distributors and Dealers Wanted

Pittsfield Machine & Tool Company

Pittsfield, Mass.

to adopt "selection by sequence" when wirelessly controlling mechanism.

A case in point was my well-known wireless-controlled airship, the construction of which I shall describe in this article.

It will be apparent that the wireless control of an ordinary model motorboat is a comparatively simple matter compared with the control of a model airship, when one considers that the former involves the "starting," "stopping" and "reversing" of one electric motor, and the movement of a rudder to "right," "left" or "central" position, whereas the latter (in the case of my model) involves the "starting," "stopping" and "reversing" of four electric motors, the control of a trapdoor, and six signal lights. In addition it will be realized that it is necessary to control mechanism for "raising" or "lowering" a model airship while in flight, which problem is non-existent in a craft floating on the surface of water.

In the construction of a model wireless-controlled airship the first consideration is "lifting power." For that purpose it is necessary to have a balloon of sufficient capacity to ensure that there will be a reserve lift of not less than ½ pound over and above the weight of the whole structure.

By adopting that precaution a great saving of hydrogen gas will be effectd, as it will not be necessary to "freshen up" the gas in the balloon as often as would be the case where "reserve of lift" had not been taken into account.

I had perhaps better explain what is meant by "freshening up." It simply consists of admitting pure hydrogen gas into a balloon in such a manner that "stale" gas may be blown out, thus restoring its lifting power.

Steering the Airship

The balloon of my airship was elongated (2'0"x5'0" dia.) as shown in Fig. 1.

It was secured to the framework of the airship by eight light cords, and was balanced on "even keel" by means of sand contained in a bag, which could be placed in any convenient position on the airship.

The framework was made of white pine, and aluminum tubes, the latter also forming "conductors" for conveying electric current from accumulators (carried at the rear of the airship) to the various motors and other mechanism, the supply of current being wirelessly controlled by a "receiver" and "controller" suspended from the center of the airship frame. A sketch of the latter is shown in Fig. 2 It consists of a compartment A, carrying accumulators N, a receiver and controller C fitted with a drum and "step by step" mechanism (for "simple selective control"), coherer H, de-cohering device I.

Steering and maneuvering of the airship is effected by means of two electric motors, and propellers mounted upon a "swivelling" beam D, so that by starting, or reversing, either or both electric motors and propellers, the airship could be caused to travel in any desired direction. while it could be raised or lowered by means of the electric motors and propellers B B.

A trapdoor E is shown attached to the frame J J J, and arranged to be released by the electro-magnet G. The latter can be energized as desired by electric current from the accumulators in compartment A. On the trapdoor E being released, it automatically cuts off the source of electrical energy from the electro-magnet G. Such a procedure prevents a waste of energy, which is a most important item in a model airship, having regard to the necessity of cutting down the weight of accumulators to the lowest practicable limit.

VERNIER RHEOSTAT

A brand new Fada necessity. A vernier arrangement added to regular Fada rheostats. Allows ultra-delicate tube filament current control—brings in long distant signals.

Fada Vernier Attachment, *the biggest little thing in radio,* instantly makes any rheostat with 3/16" shaft into vernier type.

Send 10c. for Fada Handbook. Plumb full of radio facts.

F. A. D. Andrea
1581BA Jerome Ave., N. Y. City

FADA VERNIER RHEOSTAT

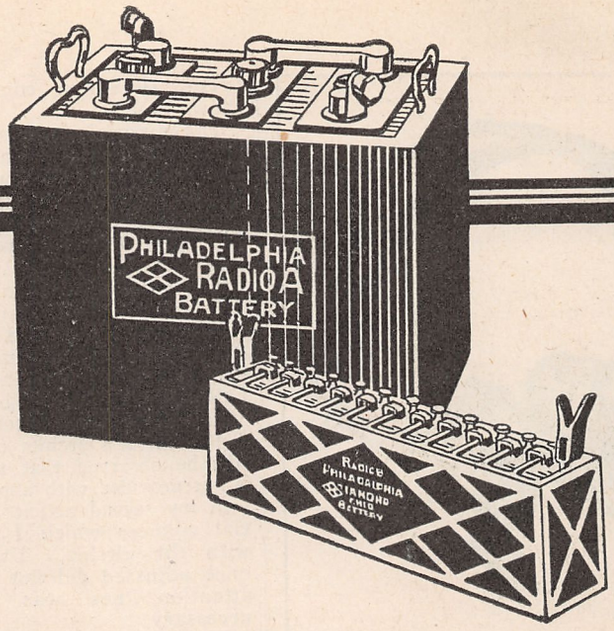
RADIO SUPPLIES AT CUT PRICES

Murdock Headsets—2000 ohm No. 56	$4.49
Murdock Headsets—3000 ohm No. 56	4.98
Federal Headsets—2200 ohm	6.25
Western Electric Headsets	10.49
Thordardson Amplifying Transformers	3.49
Jefferson Amplifying Transformers No. 41	3.49
Acme Amplifying Transformers	3.98
Eveready Variable B Battery No. 766	2.00
Eveready Variable B Battery No. 763	1.25
Eveready Variable B Battery No. 767	4.00
Cyclone Variable B Battery—22½ volt	.90
Cyclone Variable B Battery—45 volt	2.50
De Forest Crystal Sets Complete with Federal Phones	18.50
Firco (Bull Dog Grip) Phone Plug	.98
Fada Type Rheostats	.45
De Forest Type Sockets	.45
43-Plate Variable Condensers	2.00
23-Plate Variable Condensers	1.50
3½-inch Dials	.35
4-inch Electrose Dials	.98
7-strands Copper Aerial Wire	.60
No. 14 Solid Copper Aerial Wire	.40

KENSINGTON RADIO SUPPLY CO.
4417-18th Ave. BROOKLYN, N. Y.

AMERICAN TIME CLOCK REPAIR & SUPPLY CO.

SECOND HAND TIME CLOCKS
Bought, Sold, Repaired and Exchanged
ALL WORK GUARANTEED
We Carry a Full Line of Supplies
489 Broadway, near Grand St., Phone, Canal 7951



PHILCO

Drynamic Radio A and B Batteries

Stop

"frying" noises in your radio!

The new Philco Drynamic Radio Batteries absolutely eliminate objectionable battery noises. Also need for frequent and troublesome tuning in. Think of the increased pleasure and satisfaction you can now get from your radio set!

Philco Drynamic Batteries are a revolutionary development in battery engineering. Their phenomenal new "Philco Process Plates," plus other time-tested features, insure constant, uniform voltage—an absolute essential for satisfactory radio reception.

Charged DRY at the factory, the life of a Philco Drynamic Battery doesn't start until you pour in the Philco Electrolyte. That means you get a 100 per cent new storage battery. And without the inconvenience of waiting for an initial charge.

Philco Batteries also give you *the longest service per charge and the longest battery life.* They are attractively finished—sealed tight to prevent acid leakage—convenient to handle.

Ask your radio dealer to show you these remarkable new Philco Batteries — or go to the nearest Philadelphia Diamond-Grid Battery Service Staion.

RADIO DEALERS—Philco Batteries let you into the storage battery business on a package goods basis. No acid sloppage. No charging equipment. No batteries going bad in stock. Wire or write for details.

Philadelphia Storage Battery Company, Philadelphia

Makers of the famous Philco Slotted-Retainer Batteries for automobiles, electric passenger cars and trucks, mine locomotives and other high-power, heavy-duty battery services.

PHILCO
DRYNAMIC RADIO
BATTERIES

Mail This Coupon Today

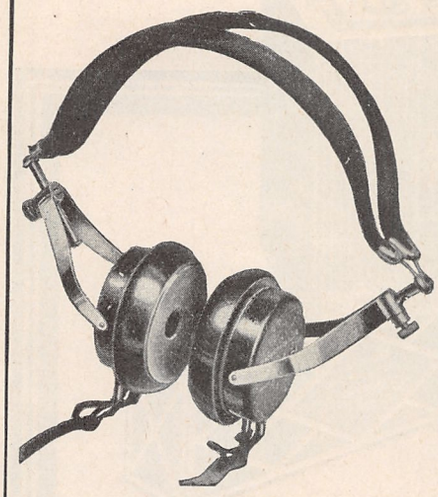
Sirs: I want to know more about the new Philco Drynamic Radio Batteries.

Name .....

Street .....

City ..... State .....

Business .....



Efficiency Plus Comfort

Both of these important features have been carefully considered in making the

Stromberg-Carlson Radio Headset

No Headset can be thoroughly efficient if it is ill-fitting. The Stromberg-Carlson Headset is quickly adjustable to any size head, fits comfortably, is extremely sensitive and reproduces accurately faint long distance signals.

The forked cord construction permits the separation of the receivers and use by two observers simultaneously.

Made by a company which has devoted 8 years to the manufacture of radio apparatus, backed by 28 years' experience in the manufacture of high-grade telephone equipment.

Order Stromberg-Carlson apparatus through your electrical merchandise dealer or write for free bulletin No. 1029R describing exclusive Stromberg-Carlson features.

Stromberg-Carlson Telephone Mfg. Co.
ROCHESTER, N. Y.

The aluminum conductor tubes are shown at F.

The airship was also fitted with two "headlights" K, green "starboard," red "port" lights L, and two red "tail lights" M.

Consideration of weight of the apparatus made it imperative to adopt a system of "selection by sequence" for the wireless control of the airship.

A system of "direct selection" would have involved the use of a much larger balloon for lifting purposes, which for demonstrations in theatres or public buildings would have been impracticable.

Fig. 10 shows a sketch of the "receiver" and "control" circuits of the airship. It will be observed that the coherer circuit is not provided with a potentiometer.

In my second article I described a special coherer which I designed for use with the airship. That coherer when once adjusted did not need any further attention, nor was a potentiometer necessary.

The circuits and mechanism shown in Fig. 10 consist of a coherer with base A, decohering device B, relay C with contacts D D, electro-magnet E with armature J, and contacts F F (one of these contacts is attached to but insulated from the armature J), coherer battery CB, insulated supports G G for rods H H (the latter representing an aerial), relay battery R B, contact drum K with a ratchet wheel P secured to one spindle on the drum.

Although not shown in the diagram (for the sake of clearness), the armature J is fitted with a "pawl," and (with the electro-magnet E) is mounted in a suitable manner so as to engage with the ratchet wheel R, so that the drum K can be caused to revolve "step by step" each time the electro-magnet E is energized (by current from the battery RB) and attracts the armature J.

M1 and M2 show the two shunt wound motors for "steering" and "maneuvering" the airship, F1 and F2 showing respectively the field magnet windings. It will be observed that these motors are connected with and controlled by the contacts on drum K; electrical energy being obtained from the battery RB.

M3 and M4 show (connected in parallel) the two shunt wound motors for "raising" and "lowering" the airship F3 and F4 showing respectively the field magnet windings (also connected in parallel.) It will be observed that these motors are also connected with and controlled by the contacts on drum K. In the interior of the latter dotted lines show crossed connections to the contact pins.

The object of this is to reverse the direction of current flowing to the armatures, but not the field magnet windings of the motors. Thus the propellers (attached to the armature spindles) can be caused to revolve in either direction as desired according to the position of the drum K.

TD shows a trap-door with supporting contact N1 and electro-magnet N. It will be observed that in operation current flows through the trap-door, contact N1, and electro-magnet N, and when the latter is energized contact N1 is broken, allowing the trap-door to fall and completely cutting off its source of electrical energy. L L show lamps (the airship was fitted with six lamps, although only two are shown). P T show insulated supports for contacts.

It will be further observed (on reference to the diagrams) that on the coherer A detecting a wireless wave, current would flow from the battery CB, energizing relay C, closing contacts D D, and admitting current from battery RB through the windings of electro-magnet E closing contacts F F, and thus energizing de-cohering

QUICK TURNOVERS
NO LEFTOVERS

Our "Superadio" parts; and all standard Radio apparatus that we distribute, are of such high quality and low price that they are sold as fast as they are displayed by the dealer. There is no better way of convincing yourself of the truth of this statement than by placing a small trial order with us. Send it today and see the demands for our equipment.

THE SUPERIOR RADIO & TELEPHONE EQUIPMENT CO.

TRADE MARK

83 E. Long St., Columbus, O.

SOMETHING NEW

$1.00

Get the fine selectivity with your set that you've been looking for!

The UNIVERNIER combines in one single unit both coarse and ultra-fine adjustments! It is a universal vernier attachment, a generous sized knob 2½ inches in diameter of polished bakelite composition, with a simple self-contained mechanism, so arranged that rotation of the knob is nearly 12 times that of the shaft of the instrument, giving extra fine selectivity. Pressure towards the panel permits ordinary coarse adjustment, thus combining rapid and delicate adjustment in one unit. Indicator rotates with the shaft, always indicating true position of the instrument.

The UNIVERNIER'S installation on any set is as simple as that of an ordinary knob. Used on Variometers, Variable Condensers, Couplers, Potentiometers, and Rheostats.

Send No Money.—Mail us your order today for one or half a dozen—and pay the postman one dollar for each when delivered! Be the first to get this wonder adjuster! Made in two sizes: No. 251 for 1-4 inch shaft: No. 188 for 3-16 inch shaft. Dealers and Jobbers write for discounts.

WALBERT MFG. CO.
925-41 Wrightwood Ave. Chicago, Ill.

UNIVERNIER

PARTS—ACCESSORIES—SETS

"FOR THE FAN"

VACUUM TUBES

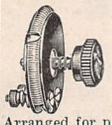
Genuine Cunningham Tubes made by the General Electric Co. Every tube guaranteed new and in original package. We do not sell "bootleg" tubes

B-C200—Detector $4.40
B-C201—Amplifier 5.90

METAL AND BAKELITE SOCKETS

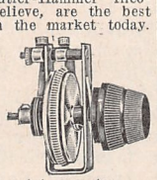
Bakelite brown finished socket for panel or base mounting. Double spring contacts held rigidly in place.
B1076—Balelite socket..$0.65
B1075—Nickeled metal socket ..... .45

VACUUM TUBE RHEOSTATS



This is a reasonably priced, smooth acting rheostat that will mount directly on back of panel. Bakelite arrow knob.
B1050—Rheostat 45c

Genuine Cutler-Hammer rheostats, we believe, are the best rheostats on the market today. Arranged for panel mounting. The picture shows the vernier type All metal parts nickeled.

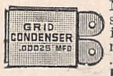


B1061—Vernier type C. H. Rheostat.....$1.40
B1062—C. H. Rheostat without vernier. .95
B1064—Howard vernier rheostat operates from one knob $1.40
B1065—Howard rheostat without vernier.. .90

VARIABLE GRID LEAK

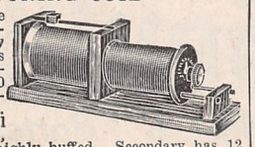
Pencil mark type. Removable black enameled cap.
B50—Grid Leak 22c

GRID AND PHONE CONDENSERS



Mounting holes spaced to fit screws of above Grid Leak. Mica insulation, wrapped with varnished cambric tape. Capacity, .00025 Mfd.
B55—Grid Condenser 18c
B59—Phone Condenser .001 Mfd.....25c

LOOSE COUPLER AND TUNING COIL

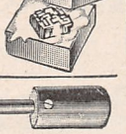


This loose coupler is preferred by many because of its wide range — 200 to 3500 meters. Mahogany finish. All metal parts are brass, nickeled and highly buffed. Secondary has 12 point switch mounted on Bakelite coil head. Windings are green silk-covered wire.
B800—Size, 5½x6x18 inch $6.50
B805—Two Slide Tuning Coil..... 2.60

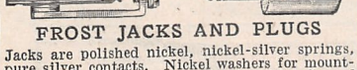
CRYSTAL DETECTOR

A very high grade glass enclosed crystal detector including the crystal. All metal parts nickel plated. Adjustable to any point on the crystal.
B20—Enclosed crystal detector $1.30
A lower priced but nicely constructed detector. Crystal included.
B30—Detector ..... .88

TESTED CRYSTALS



Selected and tested galena or silicon. Each box contains enough for four to six ordinary crystals.
B12—Galena, per pkg...$0.10
B13—Silicon, per pkg... .10



FROST JACKS AND PLUGS

Jacks are polished nickel, nickel-silver springs, pure silver contacts. Nickel washers for mounting on any panel 1-8 to 3-8 inch thick. Spread terminals make soldering easy.
B133—One spring (open circuit. Each..$0.46
B134—Two spring (closed circuit. Each.....52
B131—Four spring (two closed circuits) Each ..... .63
B135—Three spring (two open circuits, commonly called "single circuit filament control"). Each ..... .70
B136—Five spring (two open and two closed circuits, commonly called "two circuit filament control"). Each ..... .88
B132—Plug, telephone type with short knurled grip ..... .35
B137—Plug (as shown), cord tips fit into plug 1.05
B139—Plug with threaded barrel instead of set screw. Takes cord tips ..... .55

FOR EVERYONE

QUALITY APPARATUS AT LOW PRICES

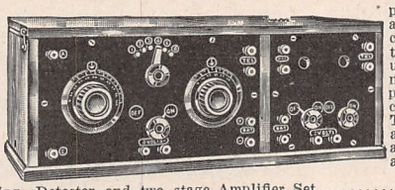
WE PAY THE EXPRESS OR POSTAGE IN UNITED STATES AND U. S. POSSESSIONS

Except Storage "A" Batteries

Your orders, small or large, shipped the day received

LICENSED REGENERATIVE RECEIVING SETS

Licensed under Armstrong Patents. Solid Mahogany case, hinged cover, shielded Bakelite panel and parts mounted on panel. Wide range, 150-800 meter.



The **BT225**, is a complete receiving set with detecting unit—and two stages of amplification as pictured above. The **BT224**, consists of complete tuning and detector unit in shorter cabinet (see division of panel). Ideal sets for concert reception. Tubes, batteries, etc., are always sold separately. Order from us and save money.

BT225—Tuska Receiving, Detector and two stage Amplifier Set $59.50
BT224—Tuska Popular Receiver and Detector Set 31.50
BT226—Tuska Two Stage Amplifier for **BT224** 36.00

OUR GARANTEE

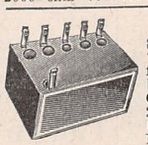
Your satisfaction guaranteed. If for any reason you do not feel satisfied with your purchase, you may return it and we will refund your money. We will pay return transportation charges.

PHONES

Genuine Frost and Brandes head sets complete with cords.

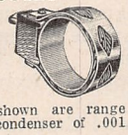
Frost **B162** — Double head sets, 2000 ohm $4.25
Frost **B163** — double head sets, 3000 ohm 4.90
B168 — Western Electric latest type double head set. List $12.00 Our price $10.50
Brandes Superior **B166**—Double head sets 2000 ohm 7.20

"B" BATTERIES



Standard high grade radio "B" batteries. Never over five days old.
B230—22½ volt Signal Corps type. Size 3½x2 x 2½ inch $1.08
B235—22½ volt U. S. Navy variable — 5 positive taps. Size, 5x3x2½. Price.....$1.80
B240—22½ volt large variable — 5 positive taps. Size, 6½x4x3. Price..... 2.25
B245—45 volt large leads only. Size, 13x4x3. Price 4.00

INDUCTANCE COILS



Rigidly wound, nicely finished, low distributed capacity. All coils are equipped with standard mountings. We can supply any of these coils without mounting plugs, for 55c less than the prices shown. The wave lengths shown are range limits, based on a variable condenser of .001 Mfd. capacity.

	Number of Turns	Wave Lengths	Price, Mtd.
B1725	25	125- 250	$0.95
B1726	35	175- 450	0.98
B1727	50	240- 720	1.05
B1728	75	390- 910	1.10
B1729	100	500- 1450	1.14
B1731	200	900- 2500	1.28
B1732	250	1200- 3500	1.36
B1733	300	1500- 4500	1.38
B1735	500	2800- 6100	1.65
B1737	750	5000-12000	1.95
B1738	1000	7000-15000	2.30
B1739	1250	9750-19500	2.55
B1740	1500	14500-26500	2.70

STORAGE "A" BATTERIES

Built of entirely new parts. With the proper care they should last several years. The De Luxe type has rubber case and cover for top as pictured, the Standard type has black wood case similar to ordinary automobile type. Guaranteed to give full rated capacity. All 6 volt batteries.

Number	Amp. Hour Rating	Shpg. Wgt.	Price
BD 60—De Luxe.....	60	40	$15.50
BD 80—De Luxe.....	80	50	17.50
BD100—De Luxe.....	100	62	20.50
BS 60—Standard.....	60	35	12.25
BS 80—Standard.....	80	40	14.25
BS100—Standard.....	100	50	16.25
BS110—Standard.....	120	60	18.25

The above storage batteries are the only items on which we do not pay transportation charges. We will ship by Express.

THORDARSON AUDIO FREQUENCY AMPLIFYING TRANSFORMER

There is probably no better known transformer. Made by a company that specializes in transformers. Entirely encased in sheet aluminum shield. Heavy connecting straps to binding posts.

B1504—Thordarson Transformers, 3½ to 1 $3.65
B1505—Thordarson Transformer, 5½ to 1 $4.20

AUDIO FREQUENCY AMPLIFING TRANSFORMERS

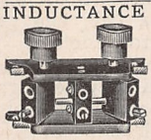
Correctly designed for minimum distributed capacity and low core loss. Shielded, beautifully finished in nickel and black enamel. Ratio 5½ to 1.
B1506—Shielded Transformer $3.75
The unshielded types listed below have terminals mounted on Bakelite panel. Two ratios.
B1510—Transformer, 10 to 1 ratio.....$3.55
B1503—Transformer, 3 to 1 ratio..... 3.50

RADIO FREQUENCY AMPLIFYING TRANSFORMERS

Radio frequency transformer circuits help to eliminate static and interference, thus permitting easy, sharp tuning of long distance stations. Enclosed in metal case for shielding and can be mounted in tube socket if desired. Wiring diagrams furnished with each transformer.

B1500—Transformer. Each.....$3.47

INDUCTANCE COIL MOUNTINGS



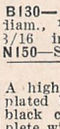
For base or panel mounting. Connecting leads furnished, coil settings are adjustable by means of knobs. Made entirely of bakelite with nickeled brass metal parts. Coil position can be locked by knurled set screws.
B1603—Three coil mounting.....$3.50
B1602—Two coil mounting..... 2.75
B1601—Single coil mounting..... .50

BINDING POSTS

Complete with screw and washer. All brass finished in polished nickel or with black composition top as listed. Order by number.

	Each	Doz.
B110—Large size, all nickeled	10c	95c
B122—Medium size, nickeled, with hole for phone tip or wire	4c	35c
B112—Medium size, black composition top.....	5c	48c
B120—Large size, composition top....	8c	85c

SWITCH POINTS & STOPS

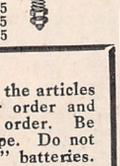


Brass, polished nickel finish. Screw size, 6/32x⅝ ins. long, two nuts with each contact point and one with the stops. Stops high enough for any type of lever and point.

	Each	Doz.	Hundred
B130— Switch Point, diam., ¼ inch; height, 3/16 inch.....	3c	20c	$1.40
N150—Switch Stops...	3c	20c	1.40

SWITCH LEVERS

A high grade, polished nickel-plated lever with solid moulded black composition knob. Complete with panel bushing, spring and two nuts.



	Each	Doz.
B151—1- in.	Radius 20c	$2.25
B152—1¼-in.	Radius 20c	2.25
B155—1½-in.	Radius 20c	2.25

HOW TO ORDER

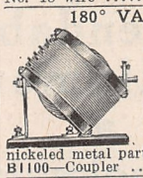
Order from this page. Please give number, description and price of the articles you order to help us avoid mistakes. Total the amount of your order and send Post Office money order, certified check or draft with your order. Be sure to give your name and street address on both letter and envelope. Do not include money for transportation. We pay it except on storage "A" batteries. See ads of previous months for other items.

FOR BUSY PEOPLE

VARIOMETERS

For efficiency, perfect inductive ratio, low capacity effect and neatness of design these variometers are unexcelled. All metal parts nickeled brass. Stator and ball mahogany finish. Furnished completely assembled and tested.
B1300—Variometer, No. 18 wire.....2.75
B1200—Variometer, No. 20 wire.....$2.75
The following knocked-down variometers have the stator windings wound and cemented ready to put in place. Two sizes of wire as listed. Complete with wire and metal parts.
B1205—Knocked-down variometer with No. 20 wire.....$1.85
B1305—Knocked-down variometer with No. 18 wire 1.85

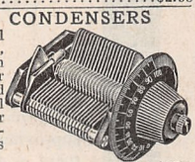
180° VARIOCOUPLER



The primary and secondary windings of this coupler are properly proportioned and spaced. The center of the secondary is always in the center of the primary field. Unlike most couplers, it aids in tuning. Black fibre base, brown formica tube and nickeled metal parts. Panel or table mounting.
B1100—Coupler $2.95

VARIABLE CONDENSERS

Very best mechanical construction. Heavy, hard aluminum plates. The vernier types are furnished with moulded dial and small knob for adjusting vernier. Plain types have ¼ inch shaft.



B1443—43 plates .001 Mfd. without dial.$2.35
B1423—23 plates .0005 Mfd. without dial. 1.80
B1411—11 plates .00025 Mfd. without dial 1.35
B1403—3 plates .00005 Mfd. without dial 1.15
B1441—41 plates vernier .001 Mfd. with dial 4.95
B1442—21 plates vernier .0005 Mfd. with dial 4.25

THORDARSON VERNIER CONDENSERS

B1523—23 plate vernier .0005 Mfd. with knob and dial.....$3.65
B1543—43-plate vernier .001 Mfd. with knob and dial..... 4.35

DIALS

Genuine Bakelite Dial as pictured. Sharply engraved divisions and figures filled with a brilliant white. Three-inch diameter, with bushing for 3/16-in. or ¼-in. shaft. Set screws included.

	Bakelite	Composition
	Each	Doz.
B500—Dial	60c	$7.00

Three-inch moulded composition dial as pictured. Has a luster that cannot be told from Bakelite. Set screws included.

	Each	Doz.
B550—Dial, 3/16-in. Shaft.....	30c	$3.00
B555—Dial, ¼-in. Shaft	30c	3.00

CABINETS

These are reasonably priced but sturdily built cabinets of weathered oak. The top is removable by loosening four screws. End posts are routed to take panel 3/16-in. thick. The panels are not included. See table for panel lengths.
B212—Can be used for detector and two step. Panel space, 5½x12.....$2.50
B214—Can be used for 2 variometers and 1 coupler. Panel space, 5½x14..... 2.75
B218—Can be used for 2 variometers 1 coupler and detector. Panel space, 5½x18 3.00
B222—Can be used for 2 variometers, 1 coupler, detector and 2 step. Panel space, 5½x22.....3.25

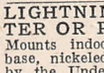
PANELS

Genuine Formica. Panels to fit our cabinets.
B262—Panel, 5½x12-in. 3/16-in. thick.$1.38
B264—Panel, 5½x14-in. 3/16-in. thick. 1.64
B268—Panel, 5½x18-in. 3/16-in. thick. 2.08
B272—Panel, 5½x22-in. 3/16-in. thick. 2.53

SPAGHETTI AND WIRE

For cabinet wiring. Yellow finish spaghetti.
B33—Per 4-ft. length 27c
B32—Tinned Copper No. 16 Wire....Ft. 2c
20 Ft. 30c
B33—Wire with insulation similar to spaghetti on it. Wire is tinned for soldering. Price 10 feet.....37c

INSULATORS



These are very strong strain type insulators.

	Each	Doz.
B360—Moulded insulator shown above	$ .10	$1.10
B365—Porcelain insulators.....	.09	.95

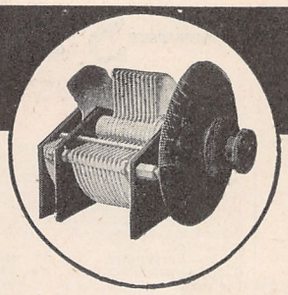
ANTENNA WIRE

The following are 100-ft coils of 7 strand cable of No. 22 wire, which makes the best Aerial. Use phosphor bronze, where the span is 100 feet or more. It is stronger.
B350—Stranded Phosphor Bronze, 100 ft. $1.47
B355—Stranded Copper, 100 ft ..... .77
B356—Single No. 14 bare solid Copper Wire, 100 ft..... .42

LIGHTNING ARRESTER OR PROTECTOR

Mounts indoors. Porcelain base, nickeled cover. Listed by the Underwriters' Laboratories under April, 1922, regulations.
B300—Protector $1.40

GREAT LAKES RADIO CO., 1124 JACKSON BOULEVARD CHICAGO, ILL.



Buy Dependable Equipment at Wholesale Prices

For over ten years we have been supplying Amateurs with equipment of proven merit. We guarantee our products because we know what goes into them—every part is made in our own plant. Our Factory-to-User sales policy eliminates the retail profit—and you get the benefit.

Illustrated Above

is a Vernier Condenser—one of the famous WIRELESS SHOP group. Just what you need for that new set. Designed for extremely accurate adjustment. Dials of FORMICA-GORTON ENGRAVED, 3¼" in diameter. Prices from **$5.25 for the 13-plate to $9.00 for the 63-plate** condenser, including Dial and Knobs.

If your name is not on our mailing list, write for our interesting folder "RN1." Invaluable to Amateurs. Shows you how to save 20% on all Radio Equipment.

THE WIRELESS SHOP A. J. EDGCOMB

1262 W. SECOND ST. LOS ANGELES, CAL.

RADIO PRICES *SMASHED*

We now announce drastic cuts in our quality lines. All goods prepaid amd sold subject to return for rebate or exchange. You simply must be pleased. A sample saving follows. Order from following or send for full list today

COMPLETE REGENERATIVE VACUUM TUBE

Range approximately 1000 miles	Our price	Others
Panel of bakelite 7 in. x 12 in. drilled	$1.65	$2.40
Cabinet of 3 ply wood to fit panel	1.50	2.50
2 three inch dials @ 35c each	.70	1.40
16 switch points with nut @ .01c	.16	.48
4 switch stops with nut @ .01	.04	.12
8 binding posts, Nickel plated @ .03	.24	.48
2 switch levers @ .25c each	.50	.90
1 filament rheostat, High grade	.65	1.10
1 vario-coupler with fourteen taps	2.25	4.00
1 23 plate variable condenser	1.95	3.50
1 tube socket of high quality	.45	.85
1 phone and 1 grid condenser @ 10c	.20	50
12 feet spaghetti tubing @ .04	.48	.84
1 tube socket support	.15	.25
15 feet tinned copper connecting wire	.30	.45
1 set blueprints for assembling	.10	.25
	$11.32	$20.02
Some other articles taken from our price list are—		
Cunningham detector tubes	3.95	5.00
Transformer-Audio frequency	2.95	4.50
Frost Fone—2000 ohms	3.95	5.00
Two stop amplifier parts complete	12.95	21.50

Radio Parts Manufacturing Company

1268 Park Place West Detroit, Michigan

device B. The "pawl" attached to the armature J would thus engage with the ratchet wheel R and move the drum K one step forward. It will thus be obvious that by revolving the drum K into various positions by each impulse from the electromagnet E (Fig. 3) the motors M1, M2, M3 and M4, also lamps L L, can be controlled as desired, while the trap-door TD can be opened once only when the drum K makes one complete revolution.

This method of "selection by sequence" worked very well in connection with the wireless control of my airship, as the drum K being a very light weight could be caused to rapidly move "step by step"; thus the inevitable starting of motors not required was really of no account owing to the short duration of contact made by the contact pins on the drum K.

I shall now describe a system of wireless control which involves "periods of time" for its operation.

For the reasons set forth the system will be described as applicable for short ranges only, but (even at short distances) it is surprising the number of interesting experiments that can be carried out with such apparatus, more especially when used in conjunction with other systems of control.

For instance, it is possible when operating a "direct selective" system to control "step by step" mechanism and, further, to operate "time period" control apparatus.

Time Period Control

Three systems of control were involved in connection with the wireless-controlled pianos which I constructed in 1912.

It is not anticipated that amateurs will undertake the construction of such a complicated piece of apparatus as would be capable of wirelessly controlling pianos. Much simpler experiments can, of course, be carried out with the systems described. Fig. 11 shows a scheme of circuits suitable for "time period" control.

These are arranged so that transmitted signals can (for example) cause a bell to ring, while it can be arranged that "continuous oscillations" will "cut out" such a bell, and cause an electric motor horn to function.

It will be understood that the circuits shown may be varied as desired, so that additional mechanism may be controlled at will.

The circuits and apparatus as shown in Fig. 11 consist of a coherer with support A, de-cohering device B, relay C, relay contacts D D, rods E E (which represent an aerial) and insulated supports for same F F, coherer battery CB, relay G with armature H. contacts I, J, K1, K2 (the latter two contacts attached to but insulated from the armature H).

The relay G is fitted with a "dashpot" (not shown in diagram) so arranged that while the armature H is free to move in a downward direction, its upward progress is retarded.

The relay L is fitted with armature M, contacts N, O, P1, P2 (the latter two contacts attached to but insulated from the armature M) and contacts O. R. A "single stroke" electric bell is shown at S, electric motor horn T, and relay battery RB.

The relay M is also fitted with a "dashpot" (not shown in diagram) so arranged that while the armature M is free to move in an upward direction, its downward progress is retarded.

It will be seen that the effect of the "dashpot" on armature M is the reverse to that on armature H.

In operation it will be observed that on the coherer A detecting a wireless wave, the ralay C will be energized by

Gould

Radio "A" Battery

Gould Radio "A" Batteries are used by the various Radio Branches of the U. S. Government. Built for continuous service. Made in sizes from 60 A.H. to 160 A.H. $17.00 to $29.00, f.o.b. factory.

"Dependability Insurance" for your Receiving Set.

The filament and plate batteries are the heart of your receiving set. When the batteries fail—the set fails. You cannot be sure of its dependability unless you are sure of the dependability of your batteries.

Using Gould Radio "A" and "B" Batteries is "dependability insurance" for your receiving set. They are especially designed and built for Radio use and contain the famous Gould Dreadnaught Plates and Armored Separators.

For a dependable source for the filament current—use the Gould Radio "A" Battery. For a source of constant, non-fluctuating plate voltage that gives a steady, continuous, noiseless service use Gould Radio "B" Batteries.

On sale by Radio Dealers and over 3000 Gould Service Stations.

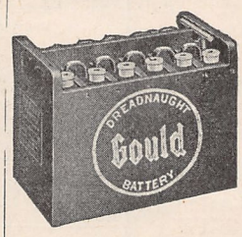
GOULD STORAGE BATTERY CO.

30 East 42nd St. New York

Plant: Depew, N. Y.

Gould

Radio "B" Battery



The compact Gould Radio "B" Battery is patented and designed to prevent grounds between cells, thus doing away with noise in headset. 24 volts in variable 2-volt steps. Non-slopping hard rubber case. Will not detract from the appearance of the finest set.

$8.00 F.o.b. Factory

If you can't get it elsewhere, try New York's Radio Center.

We quote prices gladly.

Electric Service Engineering Co.

105 West 47th St. New York City

VULCANIZED FIBRE

Be sure and specify "WILMINGTON FIBRE"

Sheets, Rods, Tubes, Washers, Etc., Specialties

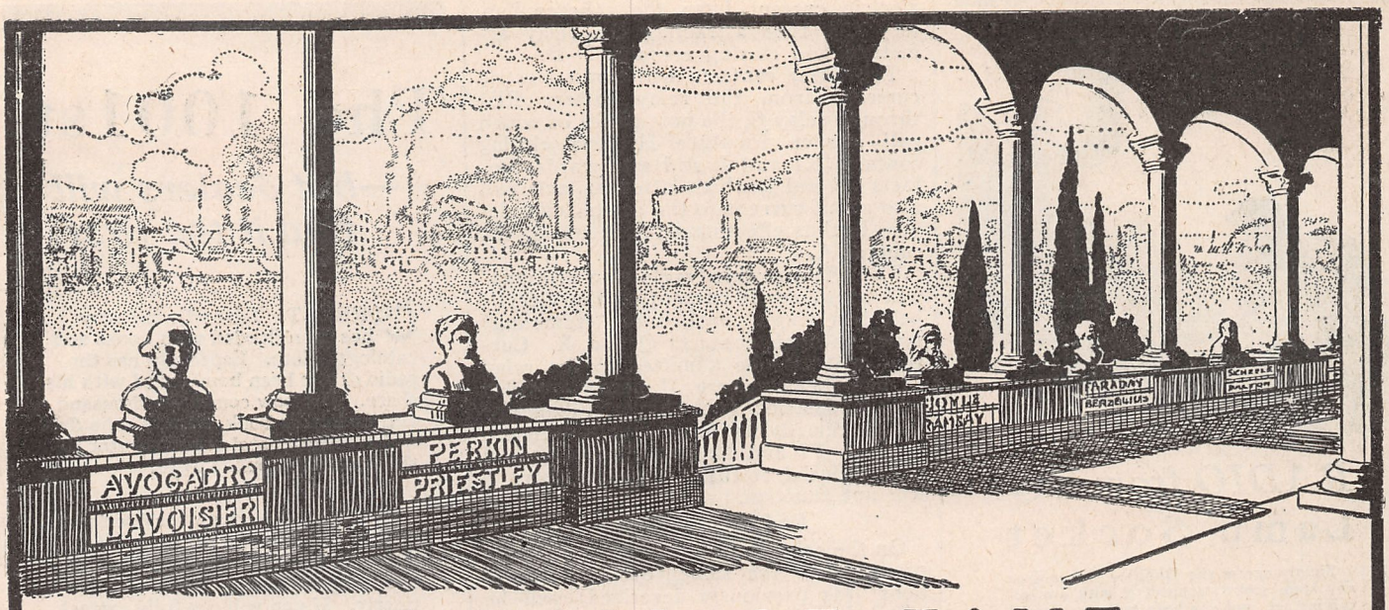
Wilmington Fibre Specialty Co., Wilmington, Del.

Branch Offices "Everywhere"

MARSHALL CONDENSERS

FULLY ASSEMBLED or READY TO BUILD

NEW HAVEN RADIO CO., Manufacturers, NEW HAVEN, Conn.



THE HALL OF FAME

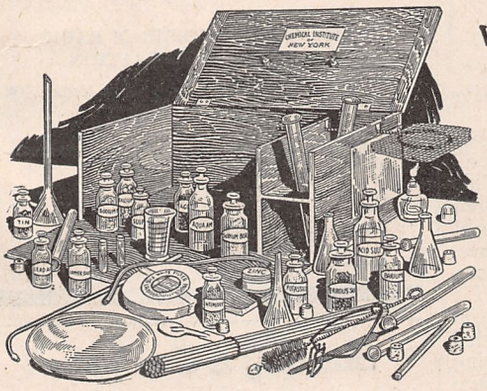
Will There Be A Niche For You?

NO man knows what is in store for him. Men now famous in business and scientific worlds were obscure only yesterday. Men today unknown may leave their names in the HALL OF FAME. Great discoveries have been born over night—marvelous scientific deeds sometimes were the results of decades of labor, other times the outcome of a scant week's research. Truly, no man can tell what the future holds for him. But it is within the power of each and everyone of us to control our own destinies, by self-training and diligent study to fit ourselves to render a lasting service to the world—a service that will bring reward, perhaps in fame, perhaps in riches. **You control your own future.**

Great Growth of Chemistry

What It Means to YOU

It is the growth of chemistry that has made the past century the most wonderful period in man's history. In a few years the chemist has changed the industrial customs of the world. In a little more than one century he has advanced civilization by ten centuries. Do you know you can learn chemistry at home in your leisure hours? You can—hundreds of others are learning now!



Dr. T. O'Conor Sloane Will Teach You Chemistry in Your Own Home

The Chemical Institute of New York, of which Dr. T. O'Conor Sloane is Educational Director, was founded to fill the need of ambitious, far-sighted men who realize and recognize the splendid future chemistry offers them, but who cannot spare the time nor the money to attend college. Dr. Sloane, a foremost authority on chemistry, will teach you and will give you any individual help you may require. He will personally go over your papers, correct them, point out your faults, and place you on the path which bears foot-prints of many who have trod it on to the HALL OF FAME.

Experimental Equipment Furnished to Every Student

We give to every student without additional charge this chemical equipment, including forty-two pieces of laboratory apparatus and supplies, and seventeen different chemicals and reagents. These comprise the apparatus and chemicals used for the experimental work of the course. The fitted heavy wooden box serves not only as a case for the outfit but also as a useful laboratory accessory for performing countless experiments. Full particulars about this special feature of our course are contained in our free book, "Opportunities for Chemists."

Easy Monthly Payments

You don't have to have even the small price of the course to start. You can pay for it in small monthly payments—so small that you won't feel them. The cost of our course is very low, and includes everything, even the Experimental Equipment—there are no extras to buy with our course. Our plan of monthly payments places a chemical education within the reach of everyone.

Chemical Institute of New York, Inc.

Home Extension Division 2. 140-R Liberty Street, New York City

Industries Need Chemists—

Pay Them Good Salaries

Industrial plants of all kinds have awakened to the need of skilled, trained chemists. Good salaries are paid them. There is no reason why you, too, cannot join this small army of trained men who are reaping material benefits from their knowledge that guards and advances civilization!

—and Special 30-Day Offer!

Besides furnishing the student with his Experimental Equipment, we are making an additional special offer for a short while only. You owe it to yourself to find out about it. Write today for full information and free book, "Opportunities for Chemists." Send the coupon right now while it is fresh in your mind. Or just write your name and address on a postal and mail it to us. But whatever you do, act today. Signing the coupon may prove the most important event in your life—mail it at once and let our book give you the facts.

Act Now!

CHEMICAL INSTITUTE OF NEW YORK
Home Extension Division 2
140-R Liberty St., New York City

Please send me at once without any obligation on my part, your free Book, "Opportunities for Chemists," and full particulars about the Experimental Equipment given to every student. Also tell me about your plan of payment and special 30-day offer.

NAME.....

ADDRESS.....

CITY.....

STATE.....R.N. 2-23

RADIO from any Lamp Socket

Simply screw the Dubilier Ducon into any lamp socket, connect it with any receiving set, and you hear radio music and speech perfectly.

The Dubilier Ducon thus does away with the antenna and the bother of erecting it.

The Dubilier Ducon is a perfect safety device, approved by the Laboratories of the National Board of Fire Underwriters.

If the Dubilier Ducon proves unsatisfactory after five days' trial, the dealer will refund the purchase price.

Dubilier Micadons

Dubilier Micadons are mica receiving condensers, ranging in price from 35 cents each to $1.00 each, depending on capacity. Because they are permanent in capacity, they reduce tube noises and thus greatly improve reception. See if your set is equipped with Dubilier Micadons. If it is not, fit it with Micadons and hear broadcasting at its best.

Dubilier Ducon
Price, $1.50

Branch Offices

San Francisco, Cal., 709 Mission St.
Washington, D. C., Munsey Building.
St. Louis, Mo., Syndicate Trust Bldg.
Chicago, Ill., 33 So. Clinton St.
Atlanta, Ga., Forsyth Bldg.
Seattle, Wash., 1926 L. C. Smith Bldg.
Los Angeles, Cal., 337 South Western Ave.
Pittsburgh, Pa., 704 Granite Bldg.
Huntington, W. Va., 1028 Fourth Avenue.

DUBILIER

Condenser & Radio Corp.

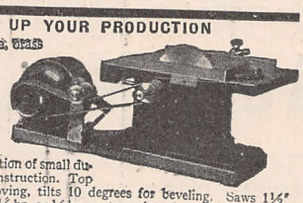
48-50 West 4th St. N.Y.

Distributed in Canada by Canadian General Electric Company, Ltd., Toronto

SPEED UP YOUR PRODUCTION

by sawing bakelite, formica, brass copper, carbon, or wood on a

JUNIOR BENCH SAW



A precision machine especially adapted to the rapid and accurate production of small duplicate parts. All metal construction. Top 10"x13" elevates for grooving, tilts 10 degrees for beveling. Saws 1½" stock. Easily driven by ¼ hp. or ½ hp. motor. Attachments for grinding and sanding. Special saws for bakelite, brass, etc., furnished from stock. Junior Bench Saw with guides and one 6" wood saw . . . $28.75
Motor Driven Unit as shown, mounted on iron base with ¼ hp. ball-bearing motor, belt tightener, belt, cord, plug, and switch, $60.00
Write for fully illustrated circular.
Manufacturers and amateurs will be interested in our Handilathe, Junior Bench Drill, Handisaw, and ball-bearing motors.
W. & J. BOICE. Dept. 702. 114-23rd St., Toledo, Ohio

RADIO MAILING LISTS

12,400 Radio Dea[lers]	[ring U. S. by States	per M. $ 7.50
1,614 Radio Mfrs.	[ ] U. S by States	per List 15.00
1,757 Radio Supply [ ]ers	covering U. S. by States	per List 15.00
257 Mfrs. who make and assemble complete Radio sets		per List 4.00
25,000 Radio Amateurs and Managers of Radio Stations		per M 7.50

Ask for price list covering Canadian and England Mailing Lists
Everything ready to send on receipt of remittance
TRADE CIRCULAR ADDRESSING CO., 166 W. Adams St., Chicago, Ill.

electric current from the coherer battery CB, thus attracting the relay armature, and closing contacts D D.

The latter contacts will admit electric current (from the relay battery RB) through relay G, the pole pieces of which will attract armature H, first closing contacts K1 and I, and afterwards contacts K2 and J, which latter contacts will also admit current to the de-cohering device B, thus effecting de-cohering of the coherer A.

The effect of this "cycle of operations" will be to admit current to the electric bell S ("single stroke" or "trembling" type) through contacts Q and R. Current will also be admitted to the relay L, but the armature M being provided with a "dashpot" (not shown in diagram) which retards its downward movement, contacts P1 and N, also P2 and O will not be closed, so that the electric horn T will not function.

End of First Series

On the coherer A detecting "continuous oscillations," the same "cycle of operations" (as previously described) will be effected, except that on account of the armature H being retarded during its "upward" movement by means of a "dashpot, contacts K1 and I will be kept closed and the "period of time" during which such "continuous oscillations" continue will enable the relay L to attract its armature M, and close contacts P2 and O, thus admitting current to the electric horn T, breaking contacts Q and R; the latter "opening" the circuit to the electric bell S, thus cutting the latter out of action.

Contacts P1 and N are only shown as "spares." It will be further observed that "continuous oscillations" may be set up by one or more transmitters, thus producing curious effects.

The apparatus and circuits described were used with great success in connection with the wireless control of musical instruments, demonstrations of which I have on many occasions given in London.

(*To be continued in the next issue*)

Radio Frequency Amplification

(*Continued from page* 1463)

plug into the standard four-prong valve holder in use there.

Fig. 4 represents a two-tube receiver of English design, in which a two-coil inter-valve transformer is used. This transformer, designed to cover a limited wave-length range, is supplied in eight different sizes in order to cover the wave-length range of 200 to 20,000 meters. They are wound with a turn ratio of 1 to 1 on an ebonite form about an inch in diameter with No. 44 S. W. G. enameled copper wire, the number of turns varying with the wave-length range. Maximum signal strength is attained by tuning the primary of the transformer by means of a shunt variable condenser C-1 to the frequency of the wave-length it is desired to amplify. Additional amplification is then secured by a feed-back condenser C-2, connected between the plate of the detector triode and the grid of the amplifier triode, as shown.

With the aim of eliminating the necessity for these additional tuning controls, various types of aperiodic or semi-aperiodic transformers have been developed.

One type, a British development, has an air core and a ratio of 1 to 1 wound with No. 45 SWG Eureka resistance wire to a resistance of about 24,000 ohms for each coil. This resistance value is above the critical value, and renders the trans-

The 1001st!

—but dealers will find it the first

CORRECT! The radio industry has been flooded with books and catalogs galore. Especially has the radio dealer been bombarded with his share. But now comes the thousand and first radio book, ***that is, the first*** which is both catalog and mentor to the dealer and public alike.

This book doesn't sell for five dollars, or fifty cents or one red cent. But to get it, friend reader, you must do one thing, and do it clearly and distinctly. If you will carefully extract your trusty Waterman from your inside vest pocket, give it a tentative shake, and print your name so our mailing department won't need to use a magnifying glass or a Sherlock Holmes to detect its significance, we will be glad to send you without one penny (red, blue or otherwise) your own individual and autographed copy of a catalog that is more than a catalog—a book that will prove your adviser and friend.

Within you will find illustrated and priced the most deservedly popular finished sets, construction sets and parts of such well known companies as Western Electric, De Forest, Acme, Sleeper, Murdock, Stromberg-Carlson, Marshall-Gerken, Atwater-Kent, Klosner, Dubilier, Briggs & Stratton, Thordarson and others.

Sign on the dotted line and Uncle Sam will do the rest.

THE NORTH AMERICAN RADIO & SUPPLY CORPORATION

5 Columbus Circle - New York City

Please send me that catalog you say so much about.

Name.....

Street.....

City.....

Starting a Company?

Save expenses and taxes by organizing on the popular, COMMON LAW plan under a pure DECLARATION OF TRUST. No experience required to fill in DEMAREE STANDARD FORMS, issue shares and begin doing business at once. Genuine DEMAREE FORMS are nationally known, approved by attorneys and utilized by successful concerns throughout the United States. Send for large, free pamphlet (C-40) containing valuable information that you may need. C. S. DEMAREE, legal blank publisher, 708 Walnut, Kansas City, Missouri.

Hear Those Distant Stations!

With the JM-6 Radio Frequency Amplifier. Absolutely dependable for clear, long distance reception

Write now for data and prices

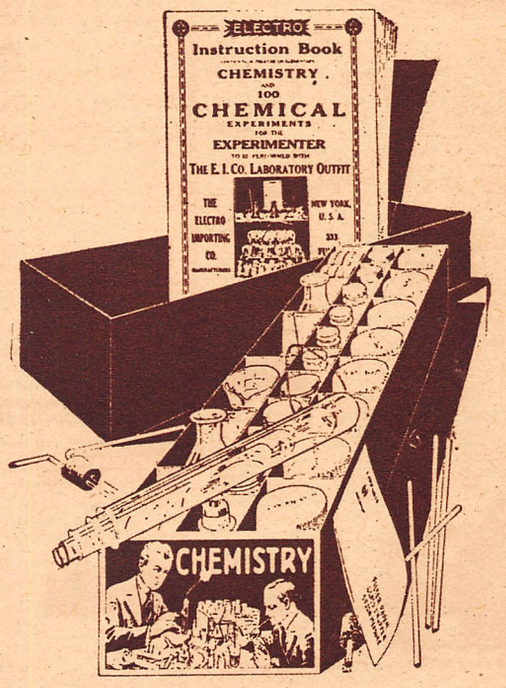
MASSEY RADIO COMPANY

Winchester Virginia

A Chemistry Laboratory for $7.00

Think of it, fellows! Here is a **real** chemistry outfit with regular chemical apparatus that performs those fascinating, actual chemical experiments.

This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive amusing experiments.



DESCRIPTION OF THE OUTFIT

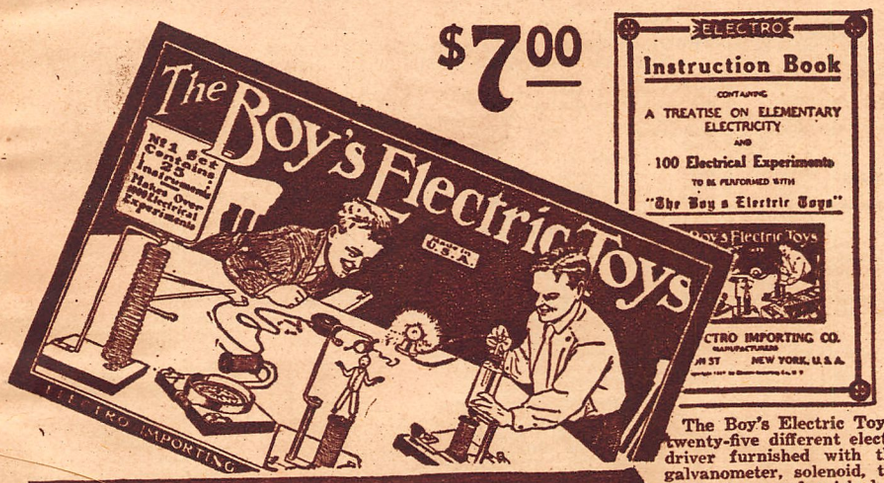
The outfit consists of forty-four (44) chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers, and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. 17 pieces of apparata furnished with this outfit.

The instruction book is a real Chemistry Course for the Beginner. Some of the Contents are: Division of Matter: This is a Treatise on Elementary Chemistry, and deals with the theory of the Elements, Molecules and Atoms, etc.

100 EXPERIMENTS

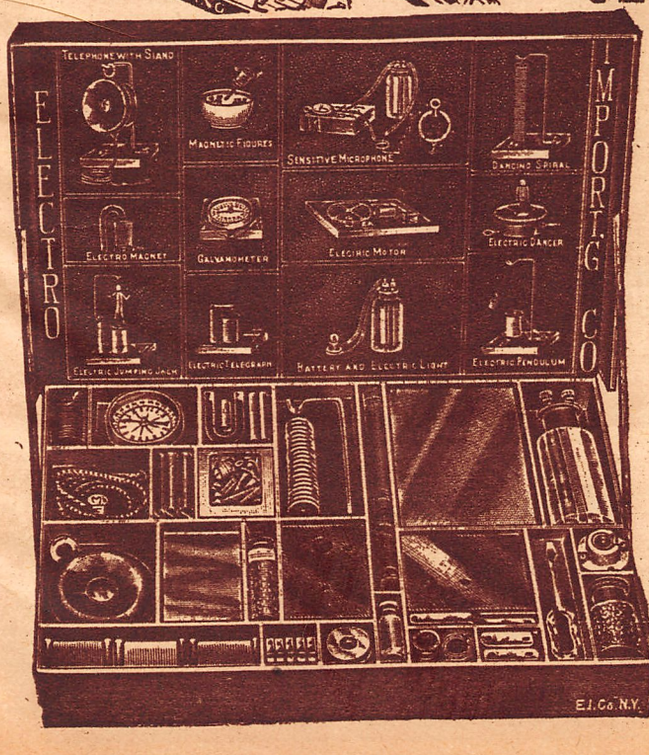
How to make chemical tricks; how to make invisible and magic inks; how to test flour; how to test soil; how to make chlorine gas and smoke (German War Gas); how to bleach cloth and flowers; how to produce oxygen and hydrogen; how to make chemical colors; how to test acids and alkalies, and hundreds of interesting hints and formulas.



$7.00

Every Fellow Wants the

BOY'S ELECTRIC TOYS



The Boy's Electric Toy contains: Enough material to make and complete over twenty-five different electrical apparatus without any other tools except a screwdriver furnished with the outfit. Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephones, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.,

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book we furnish one hundred experiments that can be made with this outfit, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by the means of this outfit, two hands and a screwdriver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

We guarantee satisfaction.

The size over all the outfit is 14 x 9 x 2¾. Shipping weight, 8 pounds. "The Boy's Electric Toys" outfit as described, $7.00. Immediate shipment.

SEND FOR YOUR SET TODAY

REMEMBER

JUST CLIP THE COUPON—DON'T SEND MONEY

ELECTRO IMPORTING CO., 233 Fulton St., New York City

ELECTRO IMPORTING CO.,
233 Fulton St., New York.

Please send me by express THE CHEMICAL LABORATORY. If I don't like it I need not accept it. If I want it I only pay $7.00 plus the few cents express charge.

.....

.....

.....

RN-2-23

ELECTRO IMPORTING CO.,
233 Fulton St., New York.

Please send me by express THE BOY'S ELECTRIC TOYS. If I don't like it I need not accept it. If I want it I only pay $7.00 plus the few cents express charge.

.....

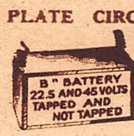
.....

.....

RN-2-23

BUILD YOUR SET WITH BARAWIK STANDARD

PLATE CIRCUIT "B" BATTERIES



You can make real savings on these batteries. Don't pay more. We guarantee them to equal any on the market regardless of price. Absolutely uniform. Extra long life.

B180 Signal Corps type, small size, 15 cells, 22½ volts. Each....95c

B182 Large Navy size, 6½x4x3, 15 cells, 22½ volts. Each....$1.75

B184 Variable Large Navy size, 5 taps, giving range from 16½ to 22½ volts in 1½ volt steps. Each....$1.80

B186 Double Navy size 6½x4x6; 30 cells, 45 volts Suitable for amplifier circuits and power tube use. Two or more of these units in series may be used in C. W. and radiophone circuits. Each....$3.40

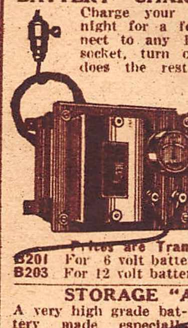
B188 Combination Tapped 45 volts, 30 cell, 6½x4x6 battery. Tapped to give 45, 22½, 21, 19½, 18 and 16½ volts. Handles both detector and amplifier tubes. Each....$3.55

WILLARD "B" STORAGE BATTERY

Better results. No battery noises. Cheaper in the long run. Easily recharged by our Battery Charging Rectifier. Leak proof glass jars. Will last for years.

B205 Price....$9.00

BATTERY CHARGING RECTIFIER



Charge your battery at home over night for a few cents. Simply connect to any 110 volt 60 cycle light socket, turn on current and rectifier does the rest automatically. Will work for years without attention. Simple connections. Gives a tapering charge which batteries should have. You can make it pay a profit charging your friends' auto batteries. Long connecting cords with pair of battery clips.

Prices are Transportation Paid.

B201 For 6 volt battery....$13.95
B203 For 12 volt battery....13 95

STORAGE "A" BATTERY

A very high grade battery made especially for radio service. Guaranteed for three years. Properly cared for will give many more years of service for filament lighting. Made of best new materials. Full capacity. The best battery buy on the market.

B194 6 volt, 40 ampere size. Each....$10.00
B196 6 volt, 80 ampere size. Each....$12.50

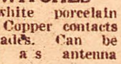
Prices are Transportation Paid.

BATTERY CLIPS

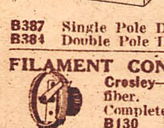
B198 Two for....28c
Clip onto storage battery terminals, lead coated. Make positive non-corrosive contact at all times.

WIRE CONNECTING CLIPS

B199 Per dozen....30c
Small connecting clips for fastening leads onto binding posts, etc. Handy and useful. Every radioist should have at least a dozen.



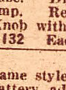
PORCELAIN BASE SWITCHES



Fine white porcelain bases. Copper contacts and blades. Can be used as antenna switches.

B385 Single Pole Single Throw. Each....20c
B387 Single Pole Double Throw. Each...32c
B384 Double Pole Double Throw Each...50c

FILAMENT CONTROL RHEOSTATS



Crosley—Wound on vulcanized fiber. Adjustable to any panel. Complete with knob.

B130 Each....45c

Best grade. High heat resisting base. Diam. 2⅛ in. cap 1½ amp. Resist. 6 ohms. 1¼ in. Knob with pointer.

B132 Each....48c

POTENTIOMETER

Same style as above rheostat. Gives fine "B" battery adjustment. Resistance 200 ohms.

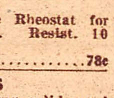
B133 Each....$1.05

VERNIER RHEOSTAT

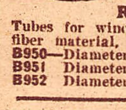
Gives exceedingly fine control of "A" battery current. A necessity for best receiving results.

B135 Each....$1.19

QUICK ACTING VERNIER RHEOSTAT



Gives very fine control of current, can be switched on or off instantly at any desired point. **B124** Each....$1.38



Porcelain Base Rheostat for table mounting. Resist. 10 ohms.

B136 Each....78c

RADIO TUBES

Tubes for winding coils. Strong solid wood fiber material, with smooth clean surface.

B950—Diameter 3 inches, per foot....20c
B951 Diameter 3½ inches, per foot....25c
B952 Diameter 4 inches, per foot....30c

WE PAY TRANSPORTATION CHARGES EAST OF THE ROCKIES

THE PRICES QUOTED DELIVER THE GOODS TO YOUR DOOR

FAST SERVICE—TRY US AND BE CONVINCED

THIS GUARANTEE PROTECTS YOU—Examine the goods we ship you. They must suit you in every respect.. If you are not satisfied with your purchase return the goods at once and we will refund the price you paid.

AGENT-DEALERS WANTED

We want Agent-Dealers to handle our line of goods in every locality. ***Our Proposition Means Money to You***

Our prices save you money. The quality of our goods insures satisfied customers. Our service will help you do a large business on a small investment.

SEND FOR OUR CATALOG

We have selected a line of goods—both completed sets and parts to assemble sets—that will enable you to supply the needs of all radio customers and make money. You can make a good income on our proposition with a very small investment.

It shows the merchandise you should handle, gives much radio information and will help you establish a successful business. Enclose 10c for the catalog. Tell us what you can and want to do, and how much you can invest. We'll do the rest. ***For the Person Who Makes His Own Set***

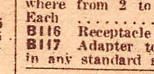
Our catalog is interesting and valuable. Even if you are not interested in radio as a business you will find many interesting things in this catalog and you will save money buying your supplies from us.

VACUUM TUBES

Standard Brands—Cunningham Radiotron. Every one guaranteed new and perfect. We will ship brand in stock unless you specify otherwise.

B105 Detector. Each....$4.45
B110 Amplifier. Each....5.95
B148 5 Watt Transmitter....7.70

MYERS TUBES



Can be used in Myers receptacle or in any standard socket with adapter listed.

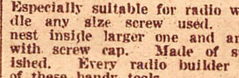
B113 High-Mu Audion. Has 5 times amplification of ordinary tubes. Oscillates anywhere from 2 to 300 volts on plate. Each....$5.00
B116 Receptacle for above. Each....1.00
B117 Adapter to adapt Myers tubes for use in any standard socket. Each....$1.05

MYERS CHOKE COIL

Designed to work with Myers tubes. Brings in loudest signals. Flexible over a broad band of wave lengths. Free from amplifier noise and distortion. Mounts in Myers special receptacle.

B119 For Audio Frequency Amplification....$3.50
B120 For Radio Frequency Amplification....5.00

FOUR-IN-ONE SCREW-DRIVER



B974 Each....55c

Especially suitable for radio work. Will handle any size screw used. Smaller drivers nest inside larger one and are held in place with screw cap. Made of steel, nickel finished. Every radio builder can use several of these handy tools.

VACUUM TUBE SOCKETS

Our Special Socket. A wonderful value. Moulded entirely of bakelite. Four binding post connections. Right angled contact springs.

B140 Each....39c

PORCELAIN BASE AND TUBE

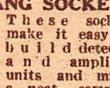
B144 Crosley for either panel or table mounting....38c

High Grade combination type for panel or table mounting. Metal tube. High insulation base.

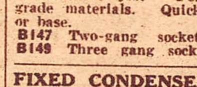
B146 Each....45c

Paragon combination type for panel or table mounting. One of the best designed and best made sockets on the market. Metal tube bakelite base.

B148 Each....$1.10



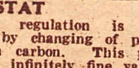
TWO AND THREE GANG SOCKETS



These sockets make it easy to build detector and amplifier units and make a neat, compact workmanlike job. Perfectly made of high grade materials. Quickly mounted on panel or base.

B147 Two-gang socket....$1.20
B149 Three gang socket....1.65

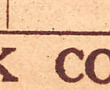
FIXED CONDENSERS



Moulded cases, nickeled binding posts.

B804 Each....48c

CARBON PRESSURE VERNIER RHEOSTAT



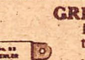
Current regulation is obtained by changing of pressure on carbon. This permits of infinitely fine variation of current. Very durable. Resistance 15 ohms. Capacity 2½ amperes.

B131 Each....$1.65

VARIABLE GRID LEAK

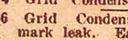
Pencil mark type. Resistance may be varied exactly as needed. **B160** Each....24c

GRID CONDENSER



B162 Mounting holes spaced to fit lugs of above leak. Cap. .00025 MF....17c
B163 Same as 162 but higher grade. Enclosed in metal case....39c

PHONE AND GRID CONDENSERS



A compact style of condenser that is very satisfactory. Conducting sheets and dielectric are wound on fiber strip with eyelets for mounting and connections. Each 12c

B170 Phone Condenser .001 Mfd.
B172 Phone Bridging Condenser .0005 Mfd.
B174 Grid Condenser .00025 Mfd.
B176 Grid Condenser .00025 with pencil mark leak. Each....24c

TUBULAR GRID LEAKS AND CONDENSERS—MOUNTED STYLE

Very convenient. Permits quick change of leaks or condensers of varying capacities.

Grid Leaks Each Price....39c

	Resistance		Resistance
B850	.5 Meg.	**B855**	2. Meg.
B851	1 Meg.	**B857**	3. Meg.
B853	1.5 Meg.	**B859**	5. Meg.

GRID AND PLATE CONDENSERS

Price, each....55c

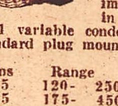
B830 .000025 Mfd. Correct for Myers Tubes.
B832 .0001 Mfd. For special circuits.
B834 .00025 Mfd. For U.V.201 and Cun.301.
B836 .0005 Mfd. For U.V.200 and Cun.300

MOUNTINGS

Bakelite base. Spring clip contact.

B840 Single mounting. Each....32c
B842 Double mounting. Each....57c
B844 Triple mounting. Each....76c

"HONEYCOMB" COILS



Carefully made—fine looking coils. Highest efficiency. Low distributed capacity effect, low resistance—high self inductance. Very firm enamel impregnation. Range given is in meters when varied with .001 variable condenser. Mounted coils have standard plug mountings.

Turns	Range	Art No.	Not Mntd.	Art No.	Price Mntd.
25	120- 250	B301	$0.39	B320	$0.97
35	175- 450	B302	.42	B322	1.00
50	240- 720	B303	.49	B323	1.07
75	390- 910	B304	.54	B324	1.12
100	500- 1450	B305	.58	B325	1.16
150	600- 2000	B306	.63	B326	1.21
200	900- 2500	B307	.72	B327	1.30
250	1200- 3500	B308	.78	B328	1.36
300	1500- 4500	B309	.82	B329	1.40
400	2000- 5000	B310	.97	B330	1.55
500	2800- 6100	B311	1.12	B.331	1.70
600	4000-10000	B312	1.27	B332	1.85
750	5000-12000	B313	1.43	B333	2.00
1000	7900-15000	B314	1.70	B334	2.38
1250	9750-19500	B315	1.92	B335	2.60
1500	14500-26500	B316	2.18	B336	2.76

COIL MOUNTINGS

B340 Three-coil mounting....$3.95
High grade fine looking mountings. Polished black composition. Center receptacle stationary, two outer ones adjusted by knobs. Takes any standard mounted coil.

COIL PLUGS

Made of moulded bakelite. Fits any standard plug. Mounts any standard honeycomb coil.

B344 Each....50c

PANEL MOUNTING COIL PLUGS

Take any standard mounted coils. Made of moulded bakelite, mounted on brackets.

B345 Stationary. Each....89c
B346 Movable with anti-capacity handle. Each....$1.10

RADIO FREQUENCY AMPLIFYING TRANSFORMER

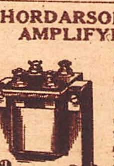
B995 Very special....$2.95
This transformer will get the long distance stations loud and clear. Permits of easy sharp tuning. Helps cut out static and interference. Makes your set sensitive enough to use a loop aerial. Enclosed in metal case affording perfect shielding. Suitable for panel or base mounting. Because of its special design can be mounted in any V. T. socket. Works with any style of tuner. Wave ranges 150 to 550 meters. Wiring diagrams included.

OUR SPECIAL AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

As high as three stages can be used without howling due to proper impedence ratio, minimum distributed capacity, low core losses and proper insulation. Mounted style has bakelite panel with binding post connections. Unmounted has core and coils assembled with two holes in core for fastening to apparatus.

B234 10 to 1 Mounted. Each....$3.69
B235 10 to 1 Unmounted. Each....2.95
B236 3 to 1 Mounted. Each....3.59
B237 3 to 1 Unmounted. Each....2.85

THORDARSON AUDIO FREQUENCY AMPLIFYING TRANSFORMER



An especially high grade transformer with correct characteristics for Cunningham, Radiatron or A. P. Tubes. Wonderful results without distortion on one, two or three steps. Low distributed capacity. Fully mounted bakelite panel.

B232 3 to 1 Ratio. Ea.$3.69
B233 10 to 1 Ratio. Ea. 4.25

RADIO CORPORATION TRANSFORMERS

Audio Frequency Amplifying Transformer. Especially designed for Radiotron tubes. 9 to 1 winding ratio.

B712 Each....$6.40

RADIO FREQUENCY AMPLIFYING TRANSFORMERS

Range 200 to 5000 meters. For long distance reception.

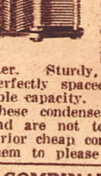
B714 Each....$5.95

OUR COMPETITOR AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

While these are very low priced transformers, nevertheless they will give excellent results. They are carefully designed and carefully made. Quantity production and small profits make the low price possible. They will equal in results many transformers selling at much higher prices.

B238 Unmounted, with wire leads....$2.00
B239 Mounted, with binding post connections....$2.75

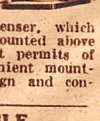
BARAWIK SPECIAL PANEL MOUNTING VARIABLE CONDENSERS



B812 43 plate .001 Mfd. 2.35
B813 21 plate .0005 Mfd. 1.90
B814 11 plate .00025 Mfd. 1.40
B815 3 plate Vernier.... 1.00

These are especially high grade condensers and we guarantee them to be mechanically and electrically perfect. Fine polished end plates of heavy bakelite. Shafts ¼ inch diameter. Sturdy, heavy aluminum alloy plates perfectly spaced to insure smooth, even reliable capacity. Our low prices save you money. These condensers are of the very best make and are not to be compared with many inferior cheap condensers offered. We guarantee them to please you or your money back.

COMBINATION VERNIER VARIABLE CONDENSERS



B824 23 plate .0005 Mfd. with dial and knobs. Price....$3.25
B826 43 plate .001 Mfd. with dial and knobs. Price....$3.95

The latest improvement in condensers consists of regular variable condenser controlled by large knob and dial mounted with a three plate vernier condenser, which is controlled by separate knob mounted above knob on dial. This arrangement permits of very fine tuning. Compact convenient mounting on panel. High grade design and construction. Finely finished.

ENCLOSED VARIABLE CONDENSERS

One of the best made condensers. Rigid, accurately spaced aluminum plates. Formica ends. Engraved scale. Knob and pointer. Clear transparent case.

B806 43 plate .001 Mfd. $3.95
B808 21 plate .0005 Mfd. $3.25

KNOCKED DOWN VARIABLE CONDENSERS

You can save money by assembling your own condensers. Formica top and base. Complete with all parts not assembled. Go together easily and perfectly. Panel moulding type.

B820 41 Plate .001 Mfd....$1.95
B821 21 Plate .005 Mfd....1.60

THE BARAWIK CO.

Chicago's Original Radio Supply House Beware of Imitators

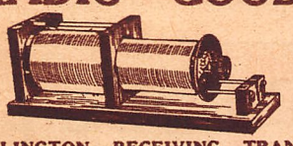
102 South Canal Street

CHICAGO, ILL.

RADIO GOODS---DEPENDABLE QUALITY---LOWEST PRICES

PRESERVE THESE PAGES—ORDER FROM THEM AND SAVE MONEY
FAST SERVICE—TRY US AND BE CONVINCED
THE PRICES QUOTED DELIVER THE GOODS TO YOUR DOOR
THIS GUARANTEE PROTECTS YOU—Examine the goods we ship you. They must suit you in every respect. If you are not satisfied with your purchase return the goods at once and we will refund the price you paid.

HOW TO ORDER—Write your Order plainly, state Article Number, Description and Price of items wanted. Send Postoffice or Express Money Order, Certified Check or Bank Draft for Total of Order.

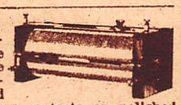


ARLINGTON RECEIVING TRANSFORMER

Will tune in all stations up to 3,500 meters. Very efficient on short waves and for radiophone reception. Used with our Detector Two Step Amplifier it produces very excellent results. Also does good work with crystal detector. Silk covered windings on formica tubes. Very fine mahogany finish wood work. Base size 6x18 inches. Slider controls primary, 12 point switch on secondary. Can be tuned very close. A wonderful value at our price.

B720 Price.....$6.48

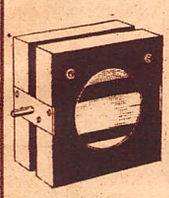
TUNING COIL



Range up to 950 meters. Wound with bare copper wire, machine spaced. Ends of mahogany finished hard wood. Two easy sliding contacts on polished brass rods, four binding posts. Substantial, efficient, attractive. Length, 8¾ in.

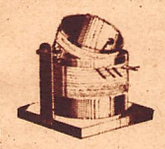
B722 Price.....$2.45

VARIOMETER



B410—Completely assembled, price $2.89
B411—Not assembled but all parts complete except wire, including winding form, $1.48
Perfect in design and construction. Accurate wood forms of genuine solid mahogany. Correct inductive ratios. Solid baked windings. Positive contacts. Highest efficiency. A real bargain.

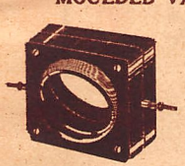
VARIO-COUPLER



With this loose coupler and two variometers, together with the necessary other parts, a highly efficient tuning set can be made. Easily mounted on panel. Primary winding on formica tube. Inductively coupled for 180 to 600 meters. Multiple taps permit fine tuning.

B415 Price, completely assembled.....$2.45
B416 Not assembled, but all parts complete except wire. Price.....$1.18
B417 Rotor ball only. Each.....29c
B408 Bakelite stator tube only. Each...35c

MOULDED VARIOMETER



Polished black moulded rotor and stator forms. Maximum inductance with greatest efficiency and minimum distributed capacity. A high grade durable instrument that will make up into a set you will be proud of and will get the best results. Wave length 180 to 600 meters. 4¼ in. square, 1⅞ in. thick.

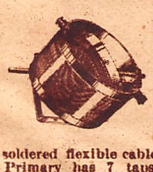
B412 Price.....$4.25
B413 Brackets for panel mounting, pair..29c
B912 3 in. Dial and knob to fit.....65c

MOULDED VARIO-COUPLER

This coupler is designed to work with the above variometer. The stator and rotor forms are of polished black moulded composition. Primary has seven taps to enable finest tuning. Wave length range 180 to 650 meters. Fitted with panel mounting bracket.

B419 Price.....$3.95
B910 Moulded dial to fit.....65c

180° VARIO-COUPLER



B418 Price.....$2.95
Our price shows you a big saving. An instrument of highest quality. The most efficient type of coupler, insures sharper tuning and louder signals. Primary and secondary wound on genuine bakelite tubes. Secondary connections through soldered flexible cables eliminates contact noises. Primary has 7 taps. Can be panel or table mounted. Range 180 to 650 meters.

BRASS ROD

Supplied only in 12 inch lengths.

B961 Threaded 6-32, per 12 inch length. 8c
B963 Threaded 8-32, per 12 inch length. 10c
B965 Solid 3-16 inch, per 12 inch length. 10c
B967 Solid ¼ inch, per 12 inch length. 12c

TINNED COPPER WIRE

Size 14 tinned copper wire. For wiring sets. Best size for neat job and proper results.

B969 Ten feet for.....12c

CHOKE COILS AND RESISTANCES

B355 100 Millihenrie Iron core choke coil. Each.....$1.20
B354 10 Millihenrie Open core choke coil. Each.....92c
B357 12,000 ohm Non-Inductive wire wound resistance. Each.....$1.58
B356 12,000 ohm Moulded resistance. Ea. 45c
B358 5 Millihenrie Open core choke coil. Each.....92c
B359 1 Henrie Iron core, choke coil. Ea. $1.20

BARAWIK QUALITY HEADSETS

These headsets have proven on rigid tests to be one of the very best on the market. The tone quality is excellent with an unusual volume. Skilled workmen make them from only the best selected materials. The receiver cases are fine polished finish with polished black ear pieces. Fabric covered head band comfortably and quickly fitted to the head. Supplied with 5-foot cord. These sets were designed to sell for much higher prices than we ask, and at our price are a wonderful bargain. We guarantee that you will be pleased with them and agree that they are the best value by far yet offered. If they don't suit you we will cheerfully return your money.

B770—2000 ohm.....$4.00

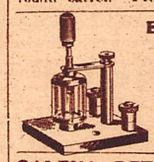
OTHER STANDARD BRAND HEADSETS

B751 Murdock 56, 2000 ohm.....$4.38
B752 Murdock 56, 3000 ohm.....4.95
B764 Frost, 2000 ohm.....4.38
B766 Frost, 3000 ohm.....4.95
B758 Western Electric, 2200 ohm.....9.50
B754 Baldwin Type C with universal jack plug.....$12.00
B755 Baldwin Type C unit with attaching cord.....$5.75
B783 Brandes, 2000 ohm.....$7.20

TWO-WAY ROUND PLUG

B397 Each.....$1.18
Takes two pairs of head set terminals. Quick easy connections. Polished round barrel. Fits any standard jack.

ENCLOSED DETECTOR



One of the finest crystal detectors on the market. Supersensitive galena crystal enclosed in heavy glass shield. Quick, positive adjustment. Brass parts polished nickel finish.

B730 Each.....$1.35

GALENA DETECTOR

Easy fine adjustment. Crystal mounted in cup. Moulded base and knob. Brass parts polished nickel finish.

B732 Each.....66c

DETECTOR CRYSTALS CAREFULLY TESTED

B736 Galena, Arlington tested, per piece 19c
B738 Silicon, Arlington tested, per piece. 19c
B735 Buzzer tested, Galena, per piece..12c
B737 Buzzer tested, Silicon, per piece..12c

DETECTOR PARTS

B725 Price set..32c
All metal parts for crystal detector. No base included. Easily assembled. Polished nickel finish.

B727 Detector Crystal Cup. Each.....10c
B728 Cat Whisker Wire, 5 feet for.....5c

BAKELITE DIAL AND KNOB

Moulded of genuine bakelite, polished black finish. Fluted knob. Fine engraved scale with sharp clear graduations and figures in contrasting white enamel. This is the finest quality dial and knob in a very attractive pattern. Two inch cannot be supplied for ¼ inch shaft.

B915 2 in. Diam. for 3-16 in. shaft. Ea. 40c
B902 3 in. Diam. for 3-16 in. shaft Ea. 49c
B903 3 in. Diam. for ¼ in. shaft. Each. 49c
B916 4 in. Diam. for ¼ in. shaft. Each. 74c

ONE-PIECE DIAL AND KNOB

Moulded in one piece of polished black composition with clean plain engraved scale and numerals in contrasting white enamel. Ribbed knob to fit the hand. An attractive neat pattern.

B900 2½ in. Diam. for 3-16 in. shaft. Ea. 32c
B901 2¾ in. Diam. for ¼ in. shaft. Ea. 32c
B904 3 in. Diam. for 3-16 in. shaft. Ea. 39c
B905 3 in. Diam. for ¼ in. shaft. Ea....39c
B906 4 in. Diam. for 3-16 in. shaft. Ea...57c
B907 4 in. Diam. for ¼ in. shaft. Ea...57c

MAGNET WIRE

Insulated copper wire. Best quality even drawn wire, one piece to a spool. Prices quoted are for 8 oz. spools.

Double Cotton Covered		Enameled Insulation		Green Silk Covered	
Number B990		Number B992		Number B991	
Gauge	Price	Gauge	Price	Gauge	Price
18	50c	20	45c	20	$0.78
20	60c	22	55c	22	.90
22	75c	24	61c	24	1.05
24	85c	26	65c	26	1.18
26	95c	30	70c	30	1.70
28	$1.15	32	79c	32	2.05
30	1.65	36	98c	36	2.75

STRANDED ANTENNA WIRE

Cabled of fine copper strands. Very flexible. High tensile strength. Best for aerials.

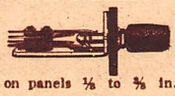
B240—100 ft. coil 65c B249—500 ft. coil $2.95

SPAGHETTI

For covering connecting wires in sets. For size 12 and 14 wires.

B955 Finest quality braided and saturated with best baked lustrous transparent insulating varnish, 3 feet for.....20c
B956 Best quality braid and covered with black insulating compound. 3 feet for.....15c

RADIO JACKS AND PLUGS



Finest grade jacks.
Improved design. Best materials. Phosphor bronze springs. Silver contact points. Nickel finish. Mount on panels ⅛ to ⅜ in. thick.

Jacks Only:
B390 Open circuit. Each.....45c
B391 Closed circuit. Each.....52c
B392 Two circuit. Each.....63c
B393 Single circuit filament cont.70c
B394 Two circuit filament cont..88c

B395 Plug. Large space with set screws for attaching cord. Each.....51c

STANDARD FLAT PLUG

B398 Each.....74c
Black polished case with polished nickel insert. Fits any standard jack. Quick, solid connections.

COMPETITOR JACK AND PLUG

Well made, durable, smooth working. Interchangeable with any standard Jacks and Plugs Solder connections. Nickel finished metal parts.

B388 Two circuit Jack. Each.....35c
B389 Standard Plug. Each.....35c

BINDING POSTS

Brass, polished nickel finish. Washer and 6-32 in. screw extending ⅝ in.

B370 Large size—barrel and knob ¾ in. long, dozen..85c
B372 Smaller size—barrel and knob 9-16 in. long, dozen.....70c
B374 Large size with composition knob, dozen.....50c
B376 Large size with hole for phone tip or wire, dozen.....80c

B378 Small size with hole for phone tip or wire, dozen.....38c

SWITCH CONTACT POINTS

Brass polished nickel finish. All have ⅝ in. long size 6-32 screws. All prices the same.
Dozen 20c Hundred $1.40
Order by Article Number.

B360 Head, ¼ in.; Diam., ¼ in. High
B362 Head, 3-16 in.; Diam., ⅛ in. High
B363 Head, 3-16 in. Diam., 1-16 in. High
Solder Lugs to Fit Contact Points
Also for connecting wires to binding posts etc.
B365 Dozen 12c—Hundred 60c

SWITCH LEVERS

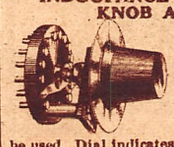
Moulded composition knob. Exposed metal parts polished nickel finish. Fitted with panel bushing, spring and two set nuts. A high grade switch.

B382 1½ in. Radius
B381 1¼ in. Radius
B380 1 in. Radius
} 22c Each

SWITCH LEVER STOP

Brass, polished nickel finish.
B386—Dozen 20c. Hundred $1.40

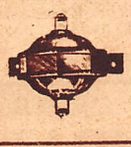
INDUCTANCE SWITCH WITH KNOB AND DIAL



Mounts switch point and contact lever behind panel. Enables you to build neat attractive set. Only one hole needed to mount on panel. 15 switch points, any number of which may be used. Dial indicates position of lever. Smooth wiping contacts. Attractive tapered knob.

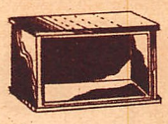
B385 Price including knob and dial....$1.80

OUTDOOR LIGHTNING ARRESTER



Including Knob and Dial
B980 Price.....$1.68
Protect your instruments with this lightning arrester. You cannot afford not to. Weatherproof porcelain case. Air gap type. Permanent. Durable. The most practical quality arrester obtainable. Underwriters approved.

CABINETS



Fine looking cabinets solidly built. Made of genuine solid mahogany in elegant hand rubbed finish. You will be proud of your set mounted in one of these cabinets. Hinged tops. Front rabbeted to take panels. Panels not included. Prices are transportation paid.

Panel Size	Inside Dimensions High	Wide	Deep	Art. No.	Price Each
6x 7"	5½"	6½"	7"	B420	$2.48
6x10½"	5½"	10 "	7"	B422	2.75
6x14"	5½"	13½"	7"	B424	3.30
7x14"	6½"	13½"	7"	B423	3.60
7x18"	6½"	17½"	7"	B426	3.90
7x21"	6½"	20½"	7"	B425	3.90
9x14"	8½"	13½"	10"	B428	3.70
12x14"	11½"	13½"	10"	B430	4.40
12x21"	11½"	20½"	10"	B432	5.25

SOLID GENUINE CONDENSITE CELORON PANELS

Notice our very low prices on this fine quality grade 10 genuine solid sheet Condensite Celoron (a product with mechanical, chemical and electrical properties like formica and bakelite). Machines well without chipping. Won't warp. Waterproof. Highest mechanical and dielectric strength. Attractive natural polished black finish which can be sanded and oiled for extra fine work.

Panel Size Inches	⅛" thick Art No.	Price	3-16" thick Art No.	Price	¼" thick Art No.	Price
6x7	B450	$0.50	B460	$0.75	B470	$0.98
6x10½	B451	.75	B461	1.11	B470	1.47
5x14	B452	1.05	B462	1.55	B472	2.05
7x14	B458	1.20	B468	1.80	B478	2.40
7x18	B453	1.55	B463	2.30	B473	3.10
7x21	B457	1.78	B467	2.65	B477	3.60
9x14	B454	1.60	B464	2.30	B474	3.10
12x14	B455	2.10	B465	3.10	B475	4.15
12x21	B456	3.15	B466	4.65	B476	6.20

ETCHED METAL NAME PLATES

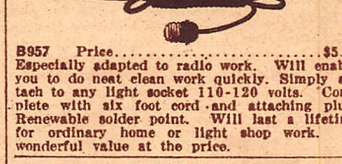
Made of brass. Silver plated characters and border on black background. All plates are 1 inch long and ⅜ inch wide, except "INCREASE CURRENT" which are quarter circle 1⅞ inch over all, and "ON" "OFF" which are ⅝ inch long. Attaching holes pierced.

B503 Per Dozen.....35c
Not less than one dozen assorted sold. Specify marking wanted as follows:

Plate Variometer	Secondary	Aerial
Grid Variometer	Primary	Ground
Vacuum	Tickler	Phones
Primary Condenser	Lead'g Coil	Input
Secondary Condenser	Coupling	Output
Increase Current (to right)	Parallel	On
	Series	Off
Increase Current (to left)	Detector	1st Step
	A Battery	2nd Step
	B Battery	3rd Step

(Blank—takes pencil or pen marks.)

ELECTRIC SOLDERING IRON



B957 Price.....$5.75
Especially adapted to radio work. Will enable you to do neat clean work quickly. Simply attach to any light socket 110-120 volts. Complete with six foot cord and attaching plug. Renewable solder point. Will last a lifetime for ordinary home or light shop work. A wonderful value at the price.

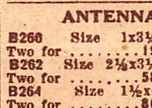
ROSIN CORE SOLDER

B958 Per Coil.....22c
Self fluxing. Especially designed for soldering electrical connections. Fine for use with above electric iron. Coil will last a long time.

TINOL

B959 Per tube.... 19c
With this preparation you can solder your connection with the heat of a match. Works fast. Makes a perfect electrical and mechanical joint. Self fluxing.

LONG NOSE PLIERS

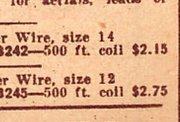


B970 Price....98c
The handiest pliers for radio work. Made of fine hardened steel. Length 5 inches.

DIAGONAL JAW NIPPERS

B972 Price.....$1.10
For fine electrical work. Made of hardened steel. Length 5 inches.

ANTENNA INSULATORS



B260 Size 1x3¼.
Two for.....19c
B262 Size 2½x3¼.
Two for.....58c
B264 Size 1½x4.
Two for.....80c
B266 Size 1½x10 x10½
Two for.....$1.35

B260 B262 B264-6

SOLID BARE COPPER WIRE

Solid bare copper wire for aerials, leads or wiring instruments.

Solid Bare Copper Wire, size 14
B246—100 ft. coil 45c B242—500 ft. coil $2.15

Solid Bare Copper Wire, size 12
B244—100 ft. coil 61c B245—500 ft. coil $2.75

THE BARAWIK CO.

Chicago's Original Radio Supply House Beware of Imitators

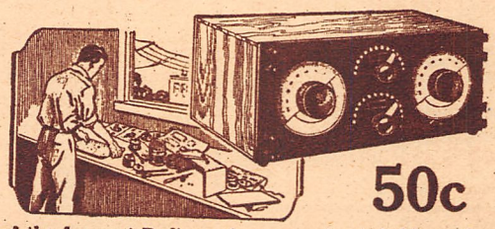
102 South Canal Street

CHICAGO, ILL.

50c EACH — THE BIGGEST SUCCESS IN RADIO: CONSOLIDATED RADIO CALL BOOK CO'S. PATTERNS and DIAGRAMS — EACH 50c

Complete Patterns, Diagrams and Instructions How to Make Your Own

SHORT WAVE REGENERATIVE RADIOPHONE SET



50c

One of the foremost Radio engineers constructed this set for us; it's simple to follow our patterns and assemble the parts comprising this set with which spark, C. W. signals and Radiotelephony may be received. We don't only give you pictures of how the apparatus looks, but each pattern is full size and printed on heavy blue print paper. Only standard parts are used.

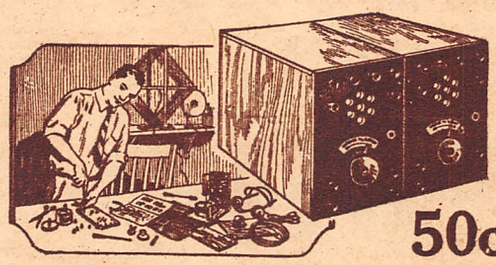
PATTERN No. 1

Consisting of a Five-Page Illustrated Direction Pamphlet, size 8½x11½ inches, One Blue-Print pattern, size 16x22 inches and One Blue-Print pattern, size 17½x22 inches, all contained in a heavy Two-Color printed Envelope, 9x11 inches.

SENT POST-PAID

DETECTOR and AMPLIFIER

RADIO UNITS



50c

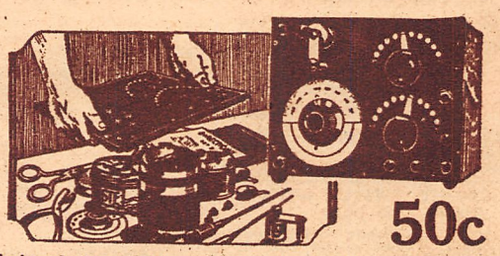
You can build this detector and the amplifier units anywhere in your house; no machine shop is needed. When built they may be used with any type of Regenerative Receiver or short wave set, with which spark, C. W. Signals and Radiotelephony may be received. We've tested these patterns by actually building the outfit—they're perfect! Only standard parts are used in making the outfit.

PATTERN No. 2

Consisting of a Four-Page Illustrated Direction Pamphlet, size 8½x11½ inches, One Blue-Print pattern, size 16x18 inches, and One Blue-Print pattern, size 13½x15 inches, all contained in heavy, Two-Color Printed Envelope, size 9x12 inches.

SENT POST-PAID

RADIOPHONE CRYSTAL SET



50c

We designed these patterns especially for those who are without technical knowledge but who are sufficiently abreast of the times to desire a radio receiving set in their homes. An instruction pamphlet comes along with the blue prints and all you have to do is follow the simple instructions. This radio set can be tuned in from stations within 30 miles. Standard materials only are used.

PATTERN No. 3

Consisting of 4-page illustrated Direction pamphlet, size 8½x11½ inches, one Blue-Print pattern size 16x22 inches. All contained in two-color printed envelope, 9x12 inches.

SENT POST-PAID

14 RADIO FORMULAE AND DIAGRAMS

Usefulness!

Economy!

Pleasure!

50c

With this packet of radio knowledge you need never worry about schematic wiring diagrams, measurements and radio tables. All formulas and diagrams are printed on heavy paper in black and blue; and contained in two-color printed envelope, 9x12 inches.

SENT POST-PAID

ALL ABOUT AERIALS

12 Diagrams How to Construct and Erect All Types of Aerials

RECEPTION and TRANSMISSION ALL FOR

50c

THESE ARE DIAGRAMS THAT EVERYONE with a radio set wants and needs. These blue prints were made after practical erection of each aerial, and point out to you how simple it is to erect not only the proper aerial for your particular need, but how to erect this aerial in the most practical manner and at the least expense.

Consists of 12 blue prints 8½x11 inches and one four-page instruction pamphlet 8½x11 inches. All contained in a heavy two-color printed envelope 9x12 inches.

SENT POST-PAID

20 Radiophone Diagrams and Hook-Ups of

Crystal and Audion Receiving Circuits, Amplifier Circuits, Regenerative Circuits, Sending Circuits

with

Key Chart of Symbols and Pamphlet "How to Read Diagrams"

50c

These diagrams show how to get the best possible efficiency from the instruments you make or purchase. They cover hook-ups from the simplest to the most complicated, in a way that any amateur can understand and follow without difficulty. Get this set, and hook up right.

All 20 diagrams are printed on heavy paper, each sheet size 8½x11½ inches, and together with KEY CHART OF SYMBOLS and pamphlet "HOW TO READ DIAGRAMS" are contained in a heavy two-color printed envelope, size 9x12 inches.

SENT POST-PAID

ORDER FROM YOUR DEALER—or direct from us

CONSOLIDATED RADIO CALL BOOK CO., Inc.

98 Park Place — **PUBLISHERS** — **NEW YORK CITY**

formers nearly aperiodic, and when connected, as per the diagram Fig. 5, have a working range of from 1,500 to 25,000 meters. Small mica or ebonite condensers are connected between adjacent plates and grids as indicated, the whole forming a combination of transformer coupled and resistance-capacity coupled amplifier. A seven-stage amplifier on this principle is used at practically all the commercial stations for transatlantic reception.

Fig. 6 represents the core details of a very easily constructed and at the same time very efficient intervalve coupling transformer, of the non-magnetic core, aperiodic type. The five discs indicated in the drawings are turned out from bakelite or ebonite and bolted together by means of 6/32 round head brass machine screws as shown. The windings are to consist of No. 38 enameled copper wire, the primary and secondary being wound in the separate grooves A and B shown. A three-stage amplifier, recently made by the writer for commercial 600-meter reception, brought in signals from Bar Harbor to Miami during daylight hours, and from Cape Race to Colon, and Darien, Panama, with strong intensity at night. The efficient wave-length range was found to be from 475 to 800 meters, with peak efficiency at 600. The number of turns used for primary and secondary windngs are shown in the diagram, Fig. 7.

Since the wave-length at which highest efficiency is attained varies with the number of turns in the windings, certain manufacturers have devised switching arrangements whereby portions of the windings may be cut out of circuit. To cover the range from 175 to 600 meters with greatest efficiency the author would recommend that two small 6-point switches be arranged to vary both windings simultaneously as follows:

Switch Point	Primary Turns	Secondary Turns
1	70	75
2	80	87
3	95	98
4	120	125
5	150	175
6	200	250

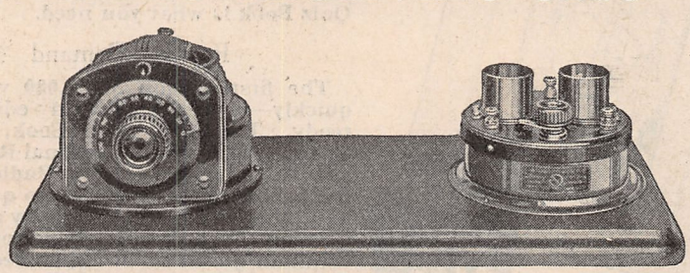
If several stages of amplificaton are used, it would be quite possible to mount the transformers and their switches in tandem, so that simultaneous turn variation could be accomplished from a single control knob, an idea, which, while not original with the author, certainly has its merits.

Several radio frequency transformers have appeared on the market employing an iron or other magnetic core. In some forms of transformer a laminated thin sheet iron core similar to that usually employed in the construction of audio frequency amplifying transformers is used, either with a closed or with an open magnetic circuit, while others have for a core finely divided soft iron imbedded in paraffin. This latter method, I believe, originated in England, where, in one form of amplifier utilizing a number of stages, this paraffin-iron core is so arranged that it may be varied in and out of the transformer windings, changing the inductance and impedance of the windings to the most favorable value for the desired wave-length. The most important effect of the introduction of a magnetic core is that the efficient wave-length range is broadened.

The constructional details of two American-made iron core transformers will, no doubut, be of interest.

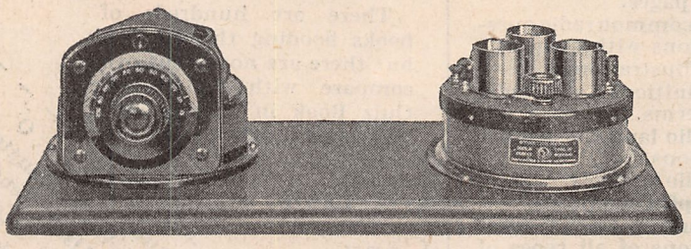
The detailed cross-sections of both transformers will be seen in Fig. 8. where a great similarity will be noted. For the

ATWATER KENT
RADIO RECEIVING SETS



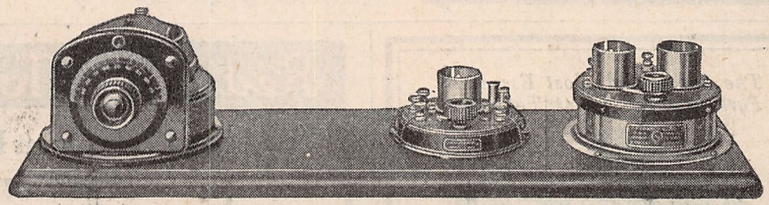
The two instruments shown above comprise an excellent and complete receiving set. The Coupled Circuit Tuner and Detector 1-Stage Amplifier on the mahogany mounting board, present a beautiful appearance.

Complete Outfit, as above, wired . . . $32.00



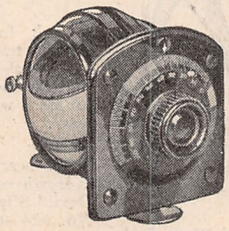
The above set, consisting of Coupled Circuit Tuner and Detector 2-Stage Amplifier, is an ideal set for either phone or loud speaker use. Note that this set includes two stages of audio frequency amplification.

Complete Outfit, as above, wired . . . $35.50



The Coupled Circuit Tuner and Detector Unit only, comprise a complete receiving set. Later, if desired, the 2-Stage Amplifier can be added for two stages of audio frequency amplification as shown above.

Complete Outfit, as above, wired . . . $37.50
Complete Outfit, as above (without Amplifier), wired, 23.50



The Mounted Variometer carries through the standard quality of ATWATER KENT products. For an open set it supplies a finished instrument unsurpassed in appearance and performance.

Mounted Variometer . $10.00

An Excellent Merchandising Proposition

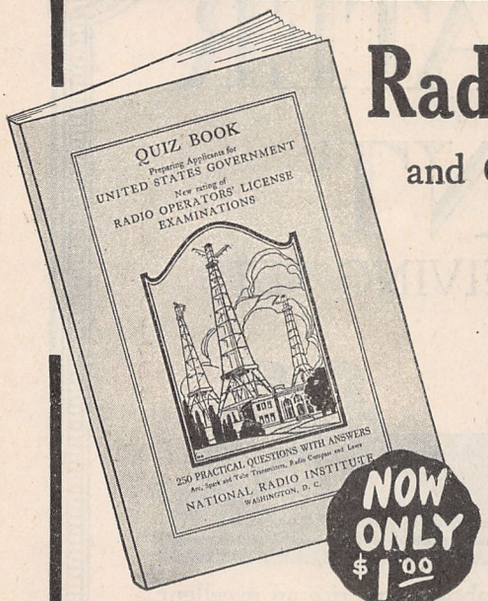
ATWATER KENT MANUFACTURING COMPANY
4943 STENTON AVENUE *Radio Dept.* PHILADELPHIA, PA.

ANSWERS ALL RADIO QUESTIONS

GET A

Radio Quiz Book

and Get a Government License



NOW ONLY $1.00

What do you want to know about Radiophone Receiving Sets?—transmitting sets?—what problems are bothering you? The second edition of the Radio Quiz Book is what you need.

Popular Demand

The first edition of 10,000 was sold quickly—now the second edition is ready. The Radio Quiz Book, written by the experts of the National Radio Institute, America's greatest Radio Training School, answers all Radio questions and especially the ones usually asked in government license examinations. 260 common questions are answered in addition to explanations of all types of receiving and transmitting sets, storage batteries, radio symbols, technical terms defined, radio laws and regulations.

CONTENTS

106 pages.
260 common radio questions with answers.
92 illustrations.
Definitions of Radio terms.
Radio laws and regulations.
Radio symbols.
Helpful equations.
Exhaustive explanations of all types of Receiving and Transmitting Sets.
Complete list of broadcasting stations.

The Only Book of Its Kind

There are hundreds of books flooding the market, but there are none that can compare with the Radio Quiz Book in valuable information for the price.

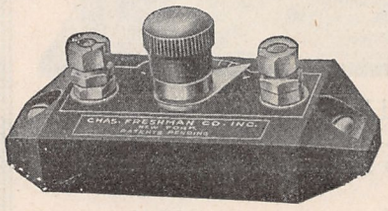
Get Your Copy Today

National Radio Institute, Dept. Q
1345 Pa. Ave., N. W., Washington, D.C.
Gentlemen: Attached is $1. Send me by return mail a copy of the second edition of your Radio Quiz Book.

Name .....

Address .....

The Latest and Most Essential Part of an Efficient Tube Set



Variable Grid Leak and Micon Condenser Combined

Obtainable in an unbroken range from zero to 5 megohms — all intermediate points. Fixed capacity—.00025 M. F. Will improve your set wonderfully by

Clarifying Signals
Lowering Filament Current
Increasing Battery Life
Eliminating Hissing

Price only $1.00

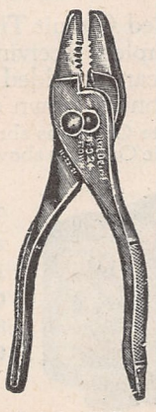
At your dealer's — otherwise send purchase price and you will be supplied without further charge.

Chas. Freshman Co., Inc.
97 Beekman Street, New York City
Home of Micon and Antenella

TRADE MARK Red Devil Tools

"Red Devil" Slip Joint Plier

The Tool of Unlimited Uses



"Red Devil" Tools American made.

THE slip joint widens its range of usefulness. The scientific handles fit the hand snugly without pinching. The powerful jaws give a non-slipping grip, and hold on tenaciously.

Look for the "Red Devil" trade mark on every tool—it's a pledge that the tool is designed for hard work and long wear.

Hardware dealers everywhere sell "Red Devil" Slip Joint Pliers. No. 924—6½ in, as illustrated, 50c. If dealer is out of stock, order direct.

Mechanic's Tool Booklet Free

SMITH & HEMENWAY CO., INC.
Manufacturers of "Red Devil" Tools
273 Broadway New York

transformer of Fig. 8A. an efficient wavelength range of from 175 to 450 meters is claimed, with peak efficiency at 360 meters, while for that of Fig. 8B, a range of 200 to 500 meters is claimed, with the same peak. Both transformers, however, have proven to be of very high efficiency in practice.

The core for transformer of Fig. 8A is composed of thin, soft iron laminations, measuring ½"x⅝", thoroughly varnished and piled up in a stack ½" high. Two special bakelite bobbins fit tightly over this core. as shown in the cross-section, and are so arranged that the adjacent primary and secondary coils are separated by ¾". Six narrow grooves are cut into each of the bakelite bobbins, each spaced 1/16" from the next. Twenty turns of No. 38 enameled copper wire are wound into each slot so formed, the series of six slots being wound in the same direction and without breaking the wire.

The completed transformer will have a primary and secondary winding, each consisting of 120 turns of wire. The starting and finishing ends of the wire have been labeled in the drawing "x, y, z, u," and in connecting up the finished transformer the method of connection indicated in Fig. 9 must be followed closely.

The core for the transformer of Fig. 8B is a duplicate of that of Fig. 8A, but there is a slight difference in the windings. Here the windings, which are of No. 28 S. C. C., consist of a primary and a secondary, each of five stagger-wound coils of 30 turns each, a total of 150 turns to each winding. In this second transformer the windings are placed directly upon the iron core. and insulated from it by a single thickness of heavy waxed pasteboard. The wire leads, which have been labeled in a manner similiar to that for the previous transformer are connected in the same manner as indicated in Fig. 9.

A copper ring M is placed over the windings, and serves to broaden the effective wave-length range of the transformer. If this ring is adjusted while signals are being received, maximum amplification can be centered at any desired wave-length.

It will be found, especially when more than one stage of amplification is employed, that under certain conditions of filament adjustment and plate voltage, oscillations will be set up in one or more of the amplifier stages. Occurring only in one stage they manifest themselves as a "mush" note in the head phones, whether detection is done with a triode or a crystal rectifier. If more than one stage in the cascade amplifier is set into self-oscillation a squeal or "beat-note" will be heard in the head phones. As a preventative of such self-oscillation a voltage divider (commonly, a "potentiometer"), may be shunted across the filament battery terminals, with a sliding contact connected to the lower end of the secondary windings as shown in Figs. 7 and 9.

A half-microfarad telephone condenser may be connected across the voltage divider in order that it will not have a damping effect on the tuned circuits.

IN NORTH DAKOTA

The following letter was received from a radio dealer in New York City.

Dear Sir I want to get agency for your Wirless aut fit as I can dispose of quit few as there is lots of moonshiners here and it wood be great thing I rote twice to one co and never heard from them So I will try yar I want full outfit so to talk 50 miles so to get ahead of Sherif. don't fail to Write Soon. Yours

H. B.

The favorite—from coast to coast

EVERYWHERE you will find up-to-date radio men who have taken the trouble to test all the various radio materials expressing a preference for Formica.

They like its beautiful finish. They like the wonderful uniformity of its dielectric strength. They like the way it works with ordinary tools. Many of them will show you high power, high frequency sets in which Formica panels and tubes have been used for years — and always given perfect service.

The preference for Formica is not confined to any one class. Manufacturers of the highest grade apparatus use it; so do skillful amateurs, and dealers everywhere prefer to sell it because of its high standing with their trade.

Formica is approved by the navy and the signal corps, and by the great majority of active radio men. Be sure to ask for it by name.

DEALERS: Formica cooperation with the dealer is complete and willing. We supply literature, counter cards, plates for advertisements. Our large capacity makes immediate delivery possible on all orders.

THE FORMICA INSULATION COMPANY
4618 Spring Grove Ave.
Cincinnati, Ohio

SALES OFFICES

50 Church Street....New York, N. Y.
9 South Clinton Street..Chicago, Ill.
415 Ohio Building.....Toledo, Ohio
414 Finance Bldg.....Cleveland, Ohio
1042 Granite Bldg.....Rochester, N. Y.
313 Title Buliding.....Baltimore, Md.
422 First Avenue.....Pittsburg, Pa.
1210 Arch Street....Philadelphia, Pa.
Sheldon Building San Francisco, Cal.

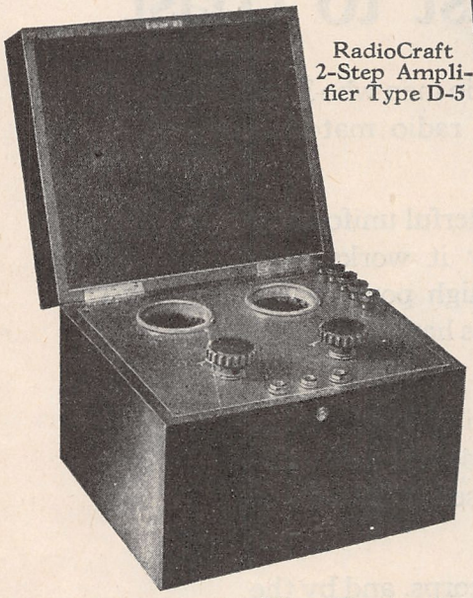
FORMICA
Made from Anhydrous Redmanol Resins
SHEETS TUBES RODS

The Regenerative Principle is Only Half the Battle

YES, it's regenerative. But there's one other point you want to know. What parts make it up? De Forest parts go into RadioCraft sets—and that tells the whole story. Here is regenerative equipment inexpensive in price and so efficient that it will bring in broadcast within a radius of 150 miles and upward.

Regenerative RadioCraft Radiophone* Type D-4
A compact and efficient Receiver that looks good and works better!

D-4 is designed for the user who wants a compact portable outfit for camping or touring. It is also ideal for the family which desires to purchase a tuner and detector unit, and after becoming accustomed to its use adding the 2-Step Amplifier, D-5, shown below, for the purpose of actuating a loud speaker. The two units are so designed, being exactly of the same size that they can be placed one beside the other and connections made by means of short wires.



RadioCraft 2-Step Amplifier Type D-5

De Forest dealers carry RadioCraft Regenerative equipment.

*By permission of De Forest Radio Tel. & Tel. Co.

The RadioCraft Co., Inc.
139 Franklin St., Jersey City, N. J.

RadioCraft

SMASHING PRICES!

Famous Pink-a-tone Crystal Radio Receiving outfits, regularly priced at $25, including double headsets	$12.00
Famous No. 2-a Stromberg-Carlson Double Headphones, 2,000 ohms	5.00
Guaranteed Auth Double Headphones, 2,200 ohms	4.00
Guaranteed Connecticut Double Headphones, 2,000 ohms	4.00
Handsome mahogany Finished Cabinets, size 7"x7"x7", with hinged cover and brass clasp and compartment for phones	2.00
Coils for crystal sets	.50
Bakelite Binding Posts engraved "TEL," "ANT" and "GNG" in white lettering, each	.10

We Pay the Postage

NATIONAL SERVICE CO.
1834 Broadway New York City

Radio Frequency Measurements

(*Continued from page* 1457)

is a variable condenser, Cx is the unknown capacity to be measured, which may be telephone cords, or an antenna insulator, capacity between windings of a transformer, etc. The small unknown condenser is connected in shunt with the known variable condenser by means of two leads. Disconnect the unknown condenser at its binding posts or terminals, leaving the two connecting leads attached to the known condenser. The object of this is to get the capacity of the known condenser with leads attached, thus enabling us to get the capacity of the unknown without the leads. Couple the two circuits loosely together so that there is no reaction between them and start the oscillator at the wave length desired. Vary the known condenser Cv until resonance is secured and note the reading of the condenser. Call this reading C_1. Now connect the unknown to the two leads at P_1P and keeping the oscillator going at the same wave length, again vary the unknown condenser Cv until resonance is secured. Since the addition of the unknown condenser in shunt increases the total by an amount equal to its capacity, namely Cx, it will be necessary to decrease the known condenser by an equal amount in order to maintain resonance, since the wave length has not been changed. Note the reading of the condenser Cv and call it C_2. From the above, since C_2 is less than C_1 by the amount of the added value Cx it follows

$$C_2 = C_1 - Cx$$
$$\therefore Cx = C_1 - C_2$$

In this manner condenser effects of values as low as 25 micromicro-farads have been measured.

The accuracy of this measurement is of course largely dependent upon fine tuning, since such small variation in condenser values can only be secured by close tuning. Close tuning will be dependent upon the coupling between the two circuits and the damping or decrement of the measured circuit. Loose coupling will assist in securing a sharp resonance curve and at the same time will result in lower damping. The measured circuit must have a minimum of resistance for low damping and hence should have a low resistance inductance L, and the known condenser Cv should be loss free as nearly as possible. Furthermore for low damping the ratio of C to L should be as low as possible, since the damping is proportional to this ratio.

(*c*). *Measurement of large condensers.* Since standards of rather large capacities are also generally not handy it is necessary to employ the following method of measurement. The circuit connections are shown in Fig. 6. The same apparatus is employed as in the measurement of above, except that in this case the unknown condenser is large and may be, for example, a telephone blocking condenser, a large condenser for a filter circuit etc. Also the unknown condenser is connected in series with the known. Start the oscillator and with the unknown condenser out of the circuit tune the known condenser Cv to resonance.

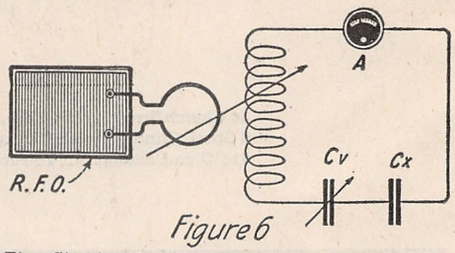


Figure 6

The Circuit Above is Employed for Measuring Large Capacities.

Great Price Reductions

WE OFFER THE FOLLOWING GOODS, ALL GUARANTEED PERFECT AND BRAND NEW, IN ORIGINAL PACKINGS. PURCHASES FROM EMBARRASSED FIRMS MAKES THIS OPPORTUNITY LAST ONLY UNTIL THE SUPPLY IS EXHAUSTED

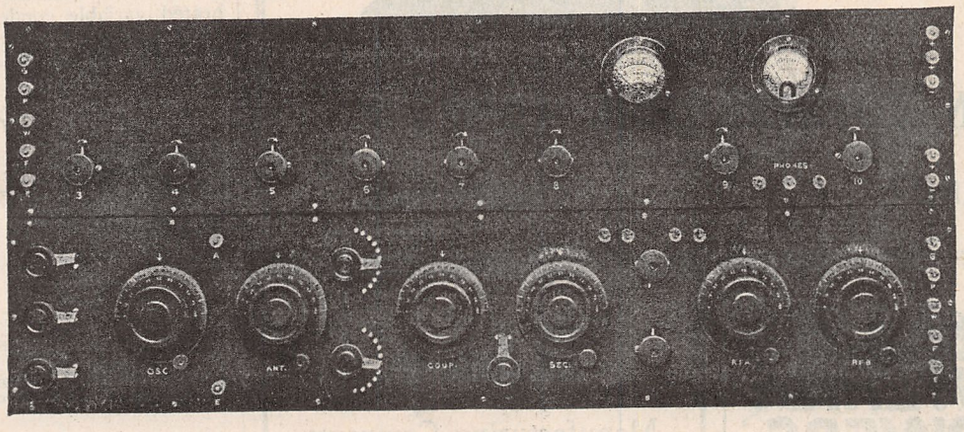
ITEM	List Price	Sales Price
Radiotrons Detectors UV200	$5.00	$3.75
Radiotrons Amplifiers UV201	6.50	4.88
Radiotrons 5 Watt UV202	8.00	6.80
Radiotrons 50 Watt UV203	30.00	27.00
Amplifying Trans. UV712	7.00	4.90
Radio Transformer UV1714	6.50	4.55
Grid Leak Holders UX543	.50	.40
R. C. Grid Leak 1, 2, 5 Megs	.75	.53
Aeriotrons WD-11	6.50	5.20
Jacks Open Circuit	.70	.49
Jacks Closed Circuit	1.00	.70
Antenna Protective Device	2.50	1.75
Storage Battery 6 volt 110 A.H.	20.00	15.00
R. C. Potentiometers	2.00	1.50
R. C. Rheostats PR535	3.00	2.25
Baldwin Phones Type C.	16.00	12.67
Western Electric Phones	12.00	9.60
Western Electric Loud Speaker	161.00	129.00
Western Electric Loud Speaker	55.00	44.00
Western Electric 216A Tubes	12.00	10.20
Variable Condensers .001 MF	4.00	2.80
Ever Ready 22½ VB Battery	3.00	1.80
Ever Ready 45 VB Battery	5.50	3.30
Bradley Stats	1.85	1.40
R-3 Magnavox	45.00	38.00
Thompson Levering Variometer	6.00	4.20
3 in. Dial and Knob, Bakelite	.90	.50

ITEM	List Price	Sales Price
4 in. Dial and Knob, Bakelite	$1.50	$1.10
Homcharges	18.50	16.00
Paragon Rheostats	1.50	1.05
Sockets	1.25	.87
Sockets	1.00	.70
Paragon Potentiometers	1.75	1.22
Audio Transformers	5.00	3.50
Telephone Plugs	1.50	1.05
Panel Switches	1.00	.70
Switch Points	.05	.03
Binding Posts	.16	.11
Transmitter Grid Leak 5 Watt	1.10	.90
Transmitter Grid Leak 50 Watt	1.65	1.10
Osc. Transformer UL1008	11.00	9.00
Dubilier Condenser .001	.45	.31
Dubilier Condenser .002	.75	.52
Dubilier Condenser .004	1.00	.70
Dubilier Condenser .005	1.00	.70
Dubilier Condenser .00025	.35	.24
Ammeter Jewell 0-500 MA	7.50	5.25
Ammeter Jewell 0-1 Amp.	7.50	5.25
Voltmeter Jewell 0-10 Volts	7.50	5.25
Thermo Ammeter Jewell 0-5 Amps.	12.00	8.40
Thermo Ammeter 0-10 Amps.	12.00	8.40
Empire Tubing	.11 ft.	.07 ft.
No. 14 Bare Copper	.01 ft.	½ ft.
No. 12 Tinned Copper	.02 ft.	.01 ft.

MANY OTHER ITEMS TOO NUMEROUS TO MENTION.
IMMEDIATE SHIPMENTS. NO C.O.D.s.

Armstrong Super Hetrodyne Receiver

"The Rolls Royce Method of Reception"—E. H. Armstrong.



Obtainable Exclusively Through

EXPERIMENTERS INFORMATION SERVICE

Designers of the Highest Class Radio Apparatus in the World

220 West 42 St., 23rd Floor **New York City**

Ask for **1923** *Catalog No.* **99**

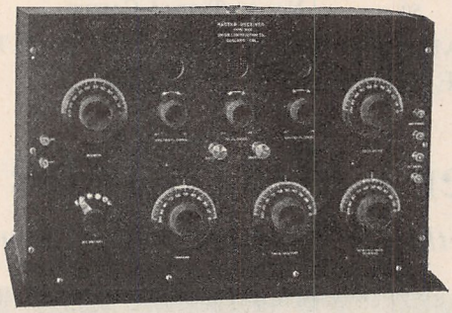
MASTER Radio Receivers "tune in" with astounding clearness within a radius of 2,000 miles. From New Mexico to New York, from Atlanta to San Francisco, the owner of a Master Receiver enjoys the pick of the nation's choicest entertainment, with reproduction so clear and exact it seems the broadcasters are in your room.

Such results are directly due to superior quality and construction of Master Receivers which are made from the choicest materials by skilled radio engineers. MASTER RECEIVERS ARE MASTER BUILT THROUGHOUT!

Master Receivers can be operated efficiently by anyone; they practically overcome radio's greatest drawback —static and undesired signals and operate with a high degree of selectivity on all wave lengths within range.

In appearance Master Receivers are something to be proud of in any gathering. Write for illustrated booklets 101 and 102.

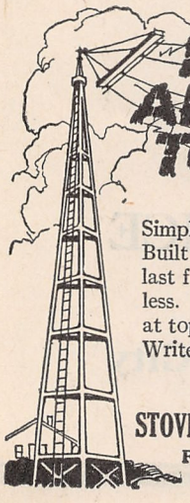
Master Receivers are Master built throughout. Parts made and assembled in our own plant.



UNION CONSTRUCTION COMPANY

Manufacturers

OAKLAND **CALIFORNIA**



RADIO ANTENNA TOWERS

Simple. Sturdy. Easy to erect. Built of galvanized steel. Will last for years. 100 ft. high or less. Fitted to take pipe mast at top. Immediate shipment. Write TODAY for prices.

Radio Department
STOVER MFG. & ENGINE CO.
FREEPORT, ILLINOIS

Belden

Manufacturing Company
Chicago

Makers of
Insulated Electrical Wires and Other First Aid Products

For the Manufacturer of
Radio Apparatus

Note its reading and call it C_1. Now connect the large unknown condenser in series with the known and again tune to resonance, the oscillator radiating at the same wave length. Note the reading of the known condenser and call it C_2. Since the wave length is the same in both cases and the inductance is the same it follows that for resonance the capacities must be the same. The capacity of C_1 must therefore be equal to the combined capacity of C_2 and Cx in series. This combined value is given by

$$\frac{C_2Cx}{C_2+Cx}$$

Hence

$$C_1=\frac{C_2Cx}{C_2+Cx}$$

$$\therefore Cx=\frac{C_1C_2}{C_2-C_1}$$

In the case of the capacity measurements previously described there was required only one calibrated condenser. In the case of inductance measurements at radio frequency it is necessary to have more calibrated apparatus, generally a known inductance and known capacity. The methods used in these measurements are all based on the resonance method as follows.

Suppose we have two radio frequency circuits coupled together as shown in Fig. 7,

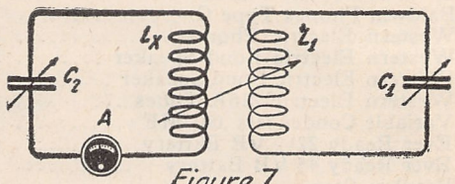


Figure 7

The Layout Above is Used for Measuring Inductance. This is Known as the "Resonance Method."

and that these circuits are in resonance. Then the following relation must be true:

$$L_1C_1=LxC_2$$

Thus if one of these circuits, say L_1C_1 is the R. F. oscillator the unknown inductance Lx can be measured provided we know the values of L_1, C_1, and C_2.

A number of methods are based on this principle, most of them being alike with slight variations. One of the best methods is that now described in which one calibrated variable condenser and one known fixed inductance is required. The circuit is shown in Fig. 8. The oscillator is loosely

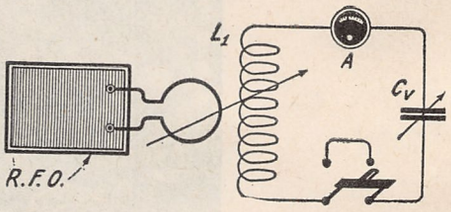


Figure 8 Lx

Another Means of Measuring Inductance. In this Circuit Only Two Known Values are Required.

coupled to the measuring circuit by means of a single loop. The circuit to be measured consists of a known fixed inductance L_1, a calibrated condenser Cv, the unknown inductance Lx, and a double pole double throw switch one side of which is shorted, the unknown inductance being connected to the other side. The two circuits are tuned to resonance, the D.P.D.T. switch being thrown on the shorted side, so that only L_1 is in circuit. Call the reading of the variable condenser C_1. Now throw the D.P.D.T. switch so that the unknown Lx is in circuit and again tune to resonance by means of the condenser Cv. Call this reading now C_2. Since the wave length has remained constant

Adds 1000 Miles with Bradleystat!

Allen-Bradley Co.:

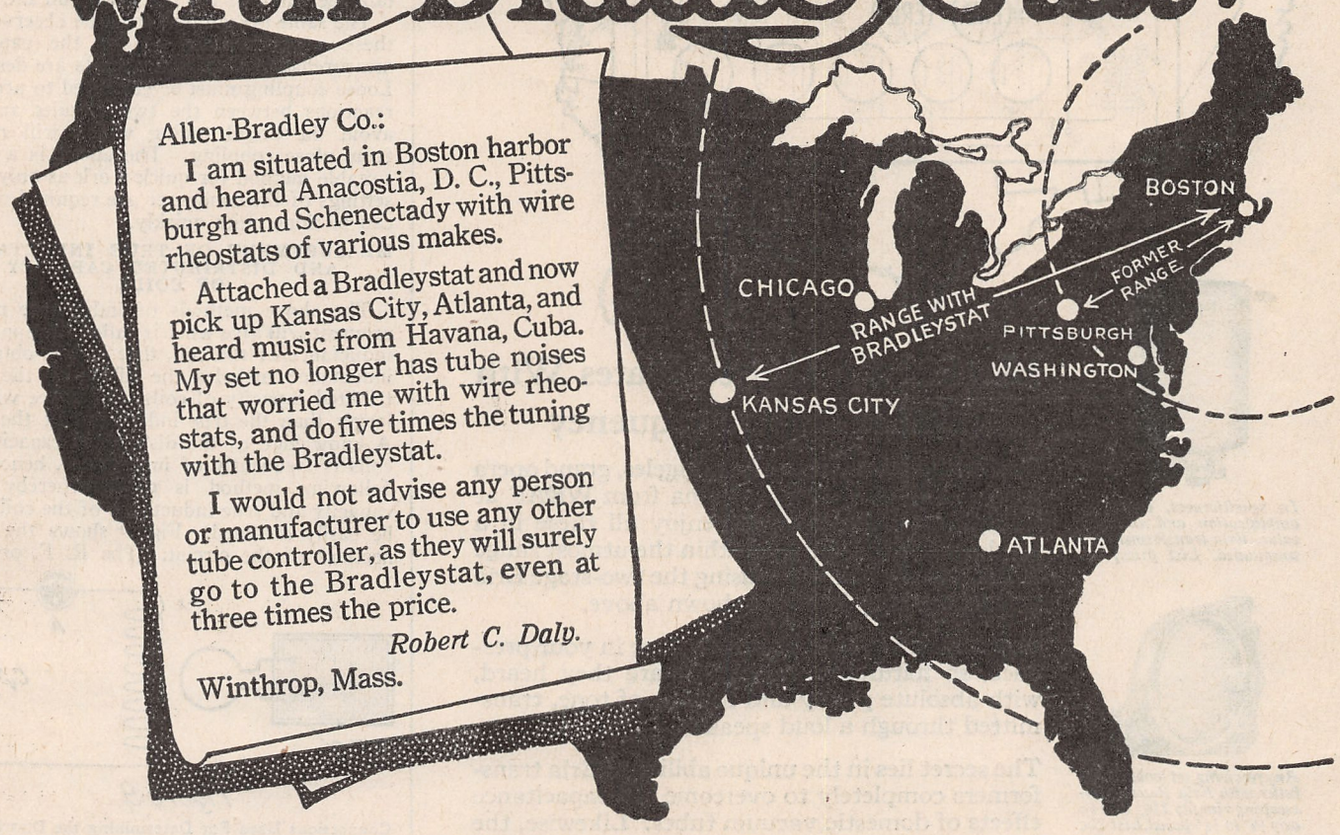
I am situated in Boston harbor and heard Anacostia, D. C., Pittsburgh and Schenectady with wire rheostats of various makes.

Attached a Bradleystat and now pick up Kansas City, Atlanta, and heard music from Havana, Cuba. My set no longer has tube noises that worried me with wire rheostats, and do five times the tuning with the Bradleystat.

I would not advise any person or manufacturer to use any other tube controller, as they will surely go to the Bradleystat, even at three times the price.

Robert C. Daly.

Winthrop, Mass.



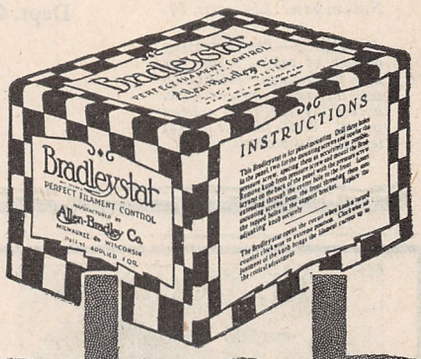
Retail Price
$1.85
P. P. 10c Extra

Fully Guaranteed Against Defects

Extend your receiving range, too!

Mr. Daly's letter is one of hundreds received from enthusiastic Bradleystat users. The improvement in range, clearness and speed of tuning surprises everyone. Try a Bradleystat, tonight.

Another Allen-Bradley product is the Bradleyometer, the perfect potentiometer. If you use a potentiometer in your set, write for latest Bradleyometer bulletin.



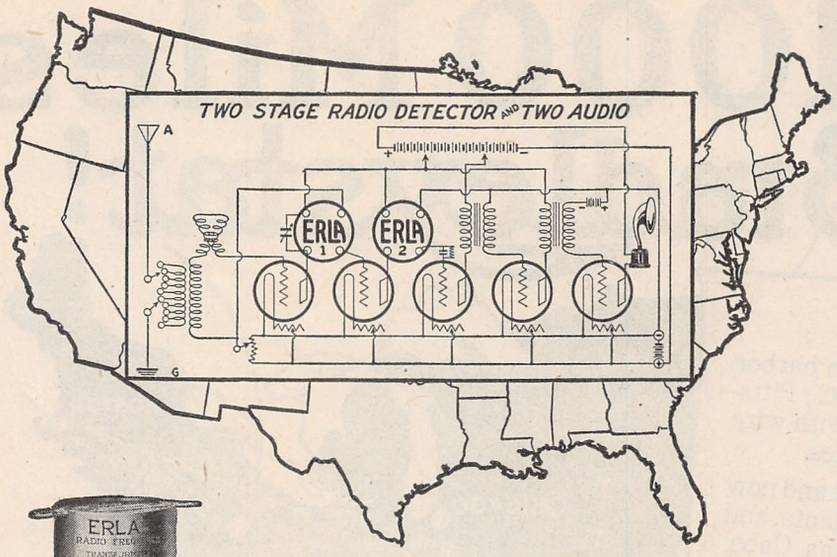
Allen-Bradley Co.
Electric Controlling Apparatus
287 Greenfield Ave., Milwaukee, Wis.

MEMBER OF
National Radio Chamber of Commerce

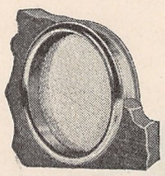
Bradleystat

REGISTERED U. S. PAT. OFF.

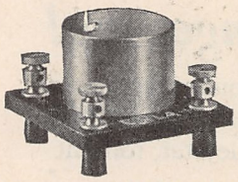
PERFECT FILAMENT CONTROL



In sensitiveness, degree of amplification and intrinsic value, Erla transformers are unequalled. List price, $4.



Any receiving set looks 100% better with Erla Bezels. Telescoping rim fits 1¼" hole in any ⅛" to ¼" panel. List 20c



The most exquisitely finished and substantial socket on the market. Heavy nickeled shell. Radion base. List price, $1.

JOBBERS—The increasing volume of repeat orders for Erla products proves that they are the right merchandise, backed by the right selling policy. Write for our liberal terms and discounts.

Blanket the United States With ERLA Radio Frequency

Vaudeville from KHJ at Los Angeles, grand opera from KYW at Chicago, drama from WEAF at New York City—you can enjoy all these in a single evening if you are within the utmost range of these stations and are using the two-stage Erla radio frequency hook-up shown above.

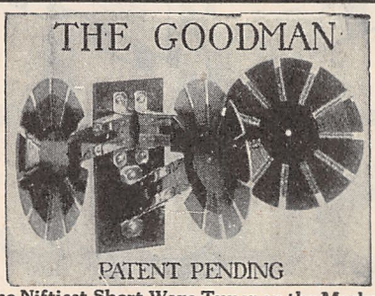
It seems as though the artists were in your presence, so naturally and clearly are they heard, with absolute purity and fullness of tone, transmitted through a loud speaker.

The secret lies in the unique ability of Erla transformers completely to overcome the capacitance effects of domestic vacuum tubes. Likewise, the capacitance of the transformers themselves is reduced, producing unequalled magnification without distortion.

Write for our Bulletin No. 12, showing guaranteed radio frequency hook-ups that will vastly improve the range and quality of your receiving equipment, with full directions for installing.

Electrical Research Laboratories
Dept. C 2515 Michigan Ave., Chicago

ERLA



The Niftiest Short Wave Tuner on the Market. Only $6 & PP on 1 lb. Send for pamphlet

L. W. GOODMAN
DREXEL HILL, PA.

Motor ———, Halifax, N. S., writes: "Delighted. Received Schenectady clearly on one tube first time I heard the GOODMAN. Would have saved trouble and money by buying months ago."

Sell Us Your Spare Time We Pay Spot Cash!

And the Big Season is Just Commencing.

Radio News and Science & Invention are the two largest radio magazines—known everywhere —and they require solicitors in every community, to obtain renewals from present subscribers and new subscriptions from others.

We pay a big commission—the same for renewal as for new subscriber.

No experience required—nothing to learn—write for order forms, sample magazines, etc., to

C. J. WOLFE,
Experimenter Publishing Co.,
53 Park Place, New York.

the following relationship must be true, where λ is the wave-length of the R. F. oscillator:

$$\lambda = L_1C_1 \text{ and } \lambda = (L_1+Lx)C_2$$
$$\therefore L_1C_1 = (L_1+Lx)C_2$$
$$\therefore Lx = \frac{C_1-C_2}{C_2}L_1$$

From this equation we can therefore obtain the value of the unknown coil Lx.

The same precautions must be observed in these measurements as for the capacity measurements if reliable results are desired. Loose coupling must be employed to prevent reactions between the two circuits and to avoid the broad tuning which will result from close coupling. The above is a very suitable method for quick work as only two settings of the condenser are required which can be done quite quickly.

MEASUREMENT OF TRUE INDUCTANCE AND DISTRIBUTED CAPACITY OF COILS

The above methods of inductance measurement will give what is called the apparent inductance of the coil, that is, this obtained inductance includes the effect of the distributed capacity of coils. and hence will be larger than the true inductance of the coil. A knowledge of the distributed capacity of coils is frequently of importance. hence the following method is given whereby this capacity and true inductance of the coil may be easily obtained. Fig. 9 shows the connections of the circuit. The R. F. oscillator is loosely coupled to a circuit containing a calibrated condenser and the unknown coil. The settings of Cv for various values of wave length as read by the oscillator are determined by the resonance method and a plot is made of the wave length squared against condenser setting, as shown in Fig. 10. This curve will be a straight line.

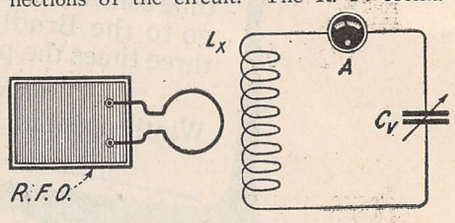


Figure 9

Connections Used For Determining the Distributed Capacity and True Inductance of a Coil.

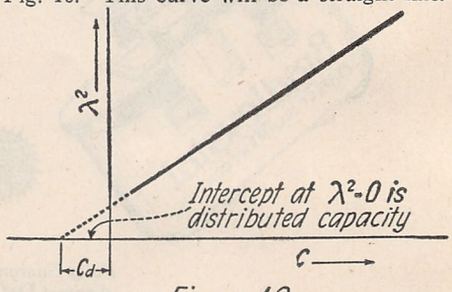


Figure 10

Plot of the Wavelength Squared Against Successive Settings of Condenser Cv.

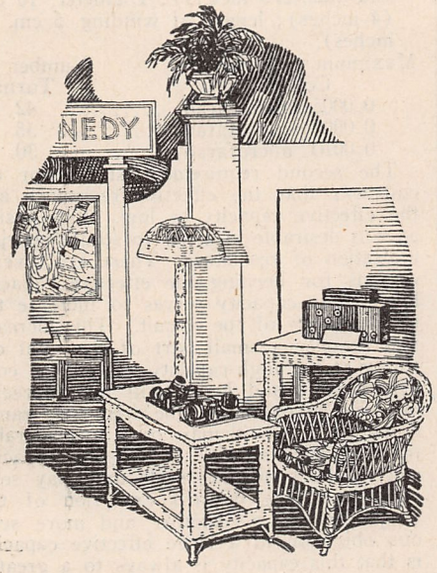
For, let Cd be the distributed capacity of the coil, and C the capacity of the condenser. Then

$$\lambda = 60\sqrt{L(C+Cd)} \quad (1)$$
$$\therefore \lambda = 3600L(C+Cd)$$

Thus since the wave length squared is a function of the first power of C and the inductance is constant, the curve must be linear. Now when X^2 is equal to zero it follows from the equation above that Cd=C, that is, the distributed capacity of the coil is the only capacity in circuit. Hence if the above curve is extended until it touches the C-axis, the intercept on the C-axis must be the distributed capacity. Knowing the distributed capacity of the coil the true inductance can readily be calibrated by substituting the equation (1) above.

BEST

A word I hate to use



ALL of you know what it means. No explanation is necessary and it conveys the idea quickly. Yet, "best" is a word that most ad writers hesitate to use because it has been so often used that it is discounted by readers. Personally, I detest it; yet when I was gathering the data for this advertisement, talking to the men who visioned, planned and are building Kennedy radio equipment, their enthusiasm and sincerity were so catching that they convinced me that Kennedy radio is the best. After investigating their claims as to the best design, the best material, the best workmanship, by talking with radio people outside of the Kennedy Company, I am still convinced that it is the best. Yet, I cannot conscientiously pass my opinion on to you who read this advertisement.

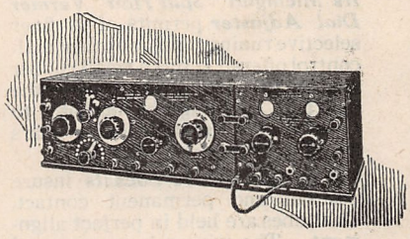
I spent a week at the Chicago Radio Show and was truly surprised at the number of people that came into the Kennedy booth and voluntarily lauded Kennedy radio equipment in terms that I should certainly hesitate to use in talking to you. For instance, one day I came upon a "ham" operator standing in front of a Kennedy 110 Universal Receiver, praising it to himself and fondling it as if it were a jewel. Upon asking him what he thought of it he answered: "This makes my set look sick. I have been in the radio game nine years. Four years ago I was an operator on a Lake steamer. I have built a set of my own and I considered it a wonder. It cost me over $600, much more than a Kennedy outfit, and it's nowheres near so good in either performance or appearance. Kennedy is the best I have ever seen and I have seen a lot of them."

One afternoon a telegrapher, or "brass pounder", as he called himself, came in and after looking over various equipment said: "I have been through every booth at the Show, and have not seen anything to compare with the Kennedy sets. They certainly are the best at the show."

On that same afternoon a man volunteered the information that while he knew very little about radio, as a shop foreman in the employ of a large electrical manufacturer he was a competent judge of good workmanship. He said: "You people certainly must employ considerable care in your shop methods. This wiring is as good as any I have ever seen anywhere; a whole lot better than that employed by most radio manufacturers. The coils are beauties and I don't think the cabinet work could be improved on. It's the best radio equipment that I ever ran across."

So, while I personally detest the use of the word, I am heading this advertisement "Best", because it is not my opinion I am expressing, and apparently the people whose comments I have quoted have no aversion to the word "best"—at least not when they refer to Kennedy radio equipment.

The Ad Writer



For broadcasting service

KENNEDY Type 281 Short-wave Receiving Set. Tuning range, 175 to 620 meters. Highly efficient for receiving from broadcasting and amateur stations. Designed throughout in accordance with the most advanced radio engineering practice. Inductively coupled circuits permit elimination of interference. Solid mahogany cabinet, hand-rubbed finish An ideal set for home entertainment. Price, including amplifier, $145.

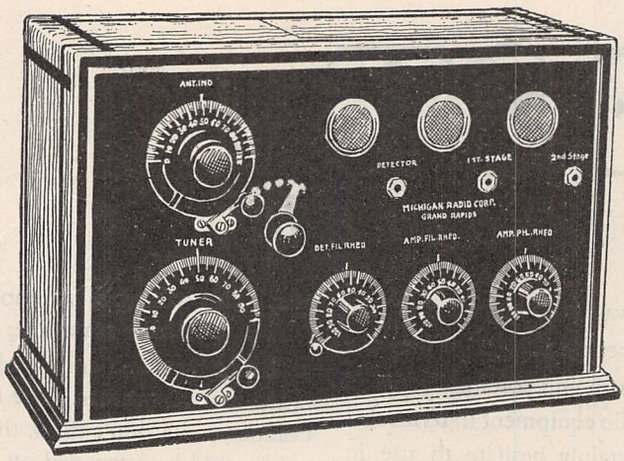
❦ ❦ ❦

All Kennedy Regenerative Receivers are licensed under Armstrong United States Patent No. 1,113,149

THE COLIN B. KENNEDY CO.
SAINT LOUIS SAN FRANCISCO

KENNEDY

83-0120-6



Michigan "Senior"

Regenerative Radio Receiving Set

A Long-Distance Wonder Worker

Built under Armstrong License (U. S. Patent No. 1,113,149) and pending letters of patent 807,388

Brings in signals clear, loud, remarkably free from distortion of any kind. Adapted to either headphone or loud speaker reception.

Its Michigan "Split Hair" Vernier Dial Adjuster permits of a finer selective tuning than any other dial-control offers. It has a small rubber washer, in friction-contact with the dial rim, enabling the operator to tune to the fraction of a hair's breadth. (Patent applied for.)

"Michigan" Tube-Sockets insure positive and permanent contact. The tubes are held in perfect alignment. The wiring is so arranged as to be out of sight—making but a few short wires necessary.

The Michigan Vernier Rheostat—Simple to operate, gives that close and fine adjustment of filament heating which is so essential to good results. The Panel is shielded which completely eliminates body capacity.

The Cabinet illustrates in no uncertain way the reason for Grand Rapid's international reputation for high-grade wood-craftsmanship. Made in brown mahogany, richly finished. It is an ornament to any home.

Send for circular. It also describes a "Junior" Set at a much lower price, for use with headphones only.

DEALERS will find this set a consistent performer, easy to demonstrate and one that makes quick and easy ***sales,*** on demonstration. Our local newspaper and other advertising helps are ***"just fine."***

Send for our discounts and terms, also catalog of Michigan Quality Radio Parts

MICHIGAN RADIO CORPORATION

GRAND RAPIDS, MICHIGAN

HYGRADE SPECIALS

7-Stranded Copper Aerial Wire, 200 ft.	$1.00
Electrose Insulators, per dozen	2.00
No. 763 Eveready Variable B. Battery	1.25
No. 766 Eveready Variable B. Battery	2.25
No. 767 Eveready Variable B. Battery	4.25
45 Volt Cyclone Variable B. Battery	2.50
Arkay Loud Speaker	3.89
Thordarson Amplifying Transformers	3.49
Acme Amplifying Transformers (Mounted)	4.00
Federal Amplifying Transformers	5.75
Skindervikin Transmitter Buttons	75c
Firco Bull Dog Grip Phone Plug	98c
2000-Ohm Murdock No. 56 Head Set	4.49
3000-Ohm Murdock No. 56 Head Set	4.98
Federal 2200-Ohm Head Set	6.50
Dictograph 3000-Ohm Head Set	6.98
Western Electric Head Set	9.75
6 Volt 30 Amp. *Marko Storage Batteriets*	$ 8.95
6 Volt 60 Amp. *are*	11.95
6 Volt 80 Amp.	15.45
6 Volt 100 Amp. *Guaranteed Two Years*	22.95

HYGRADE ELECTRICAL NOVELTY CO.

41 West 125th Street New York, N. Y.

World Radio Batteries SAVE YOU 50%

WRITTEN 2 YR. GUARANTEE

Direct factory to user sales methods save you 50%. Highest quality material insures you 100% service. Every battery backed by our written two-year guarantee. You take no risk. Batteries shipped express C. O. D. for your inspection. Mail your order today—at once.

COMPARE THESE PRICES

RADIO PRICES:

6 Volt. 40 Amps.	$ 8.50
6 Volt. 60 Amps.	10.00
6 Volt. 80 Amps.	12.50
6 Volt. 100 Amps.	14.50

No other manufacturer offers such a high quality battery at such a low price. Save 50 per cent on your next battery and get better and longer service—buy a **World Storage Radio Battery.** Write today.

World Battery Co., 1219 S. Wabash Ave., Dept. 1, Chicago

Design of a Portable Short Wave Radio Wavemeter

(*Continued from page* 1476)

second (100-25 meters); Diameter, 10 cm. (4 inches); length of winding, 2.5 cm. (1 inch).

Maximum capacity of Condenser	Number of Turns
0.0005 microfarad	16
0.0007 microfarad	13
0.0010 microfarad	11

Coil 2, Range 1,330-530 kilocycles per second (225-570 meters); Diameter, 10 cm. (4 inches); length of winding, 5 cm. (2 inches).

Maximum capacity of Condenser	Number of Turns
0.0005 microfarad	42
0.0007 microfarad	35
0.0010 microfarad	30

The second requirement stated for the coil was that the effective resistance and the effective capacity be low. Low resistance is desirable in order to secure sharper indication of resonance There are several reasons for keeping the effective capacity low. This capacity serves to increase the total capacity of the circuit. This increase will be only a small part of the total capacity at the high-capacity end of the condenser scale and hence will not appreciably help in extending the frequency range downward, but it may be a considerable part of the capacity at the low-capacity end of the condenser scale and may seriously limit the upward extension of the frequency range. Another and more serious objection to a large effective capacity is that this capacity is always to a greater or less extent subject to variation as a result of change in the surroundings of the coil. Since this capacity cannot be controlled, it should be, as far as possible, reduced. The practice of surrounding an inductance coil with quantities of miscellaneous insulating material is undesirable in any radio circuit and is especially to be avoided in the case of wavemeter coils. Imperfect insulating materials so used increase not only the effective capacity but also the effective resistance of the coil. This does not mean that all types of manufactured insulating materials are unsuitable for use in frames for wavemeter coils. Probably, however, the best form on which to wind the coil of a wavemeter like that here described is a hollow spool of thoroughly dry wood lightly varnished with an extra grade of insulating varnish. The use of shellac is not considered advisable under any circumstances. The use of wood having even a comparatively small moisture content may seriously affect the accuracy of the wavemeter. Properly selected wood is chosen in preference to manufactured insulating materials, glass, or pasteboard. Many available manufactured insulating materials largely increase both the resistance and the capacity of the coil. While the electrical properties of glass make it well suited for a form, it presents too great mechanical difficulties. Pasteboard is not rigid enough and should not be used under any circumstances

The wire used may be solid copper double cotton covered, No. 24 B. & S. or larger. The wire should be lightly varnished with a single coat of an extra grade of insulating varnish. Further insulation merely increase the effective resistance and capacity of the coil without compensating advantages. The resistance can often be considerably reduced by the use of braided high-frequency cable. Care must be taken, however, in using the high-frequency conductor to see that all the strands are continuous and well insulated from each other and that every strand is joined at the terminals of the coil. If imperfect insulation exists between adjacent strands, these high-resistance contacts may cause a

Ask your dealer to show you the

MAR-CO LINE of RADIO Products

Perfect in Design, Finish, and Workmanship
MAR-CO *Products are Electrically Correct*

Shur-Grip Plug $1.50
NICKEL FINISH. No tools necessary to connect. The Perfect Plug.

Sta-Put Plug 60c.
Practical—Efficient—Reliable—No tools to connect.

MAR-CO Jacks 65c-$1.10
(Five styles). Open, Single, Double Circuit, Single and Double Filament. Control. Built to give a lifetime of service—Formica or Fibre insulation.

MAR-CO Vernier Rheostat $1.50
Remarkably fine adjustment. Critical Filament easily controlled. 6 ohms resistance. 2 ampere capacity. Also very effective in use with WD11 Tube.

MAR-CO Standard V. T. Socket 90c.
A perfect reinforced bakelite socket—double contact.

MAR-CO W.D.11 Tube Socket 80c.
Compact. Positive contact. Easy to mount.

MAR-CO W.D.11 Tube Adapter 90c.
An adapter that is electrically and mechanically perfect.

MAR-CO Pull Switch 90c.
A simple practical battery switch. Only one hole necessary for panel mounting.

MAR-CO Inductance Coils 40c-50c.
Three sizes.

MAR-CO Tuner $7.00
A radical new development in tuning devices.

The Marcophone Receiving Outfit

MAR-CO RADIO PRODUCTS

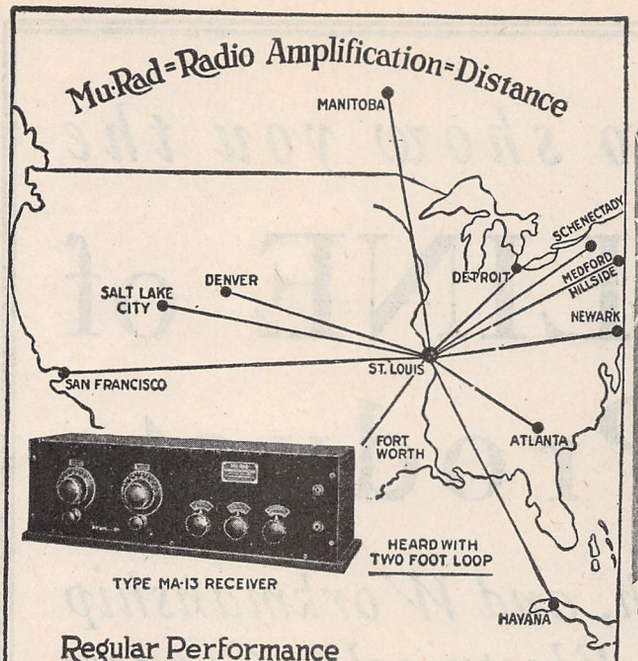
A high grade, super-sensitive unit that can be operated by a novice.

Write for any desired information.

MAR-CO RADIO PRODUCTS

MARTIN-COPELAND COMPANY

Providence, R. I.



Regular Performance of

Mu-Rad Receivers

INVENTIONS by Mu-Rad engineers are establishing new high standards of radio reception. A Mu-Rad Radio Frequency Receiver with a small loop aerial is more sensitive, more selective, simpler to operate and more compact than any other type of receiving equipment. These are *facts*, determined by impartial tests and comparisons.

Guaranteed for 1000 Miles Reception

We substantiate these claims by a positive, written guarantee on each Mu-Rad Receiver of 1000 miles reception on a loop—another innovation in the marketing of radio receivers.

See These Sets at Your Dealers

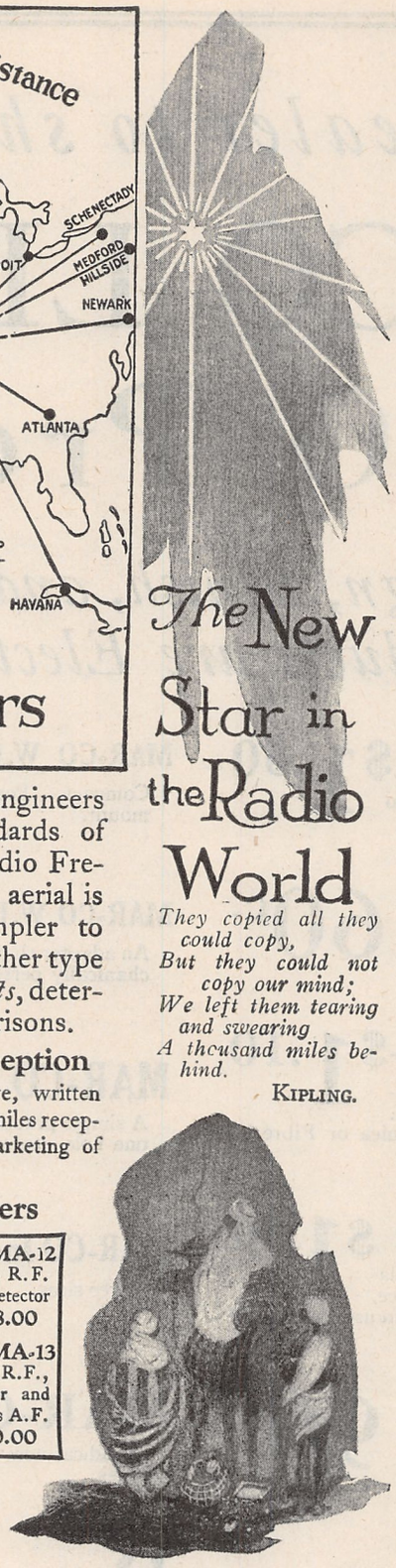
Ask him to show you their construction and operation. Note the rigid buss wire connections, the high quality workmanship throughout, the fine finish of the mahogany cabinet, the polished Radion panel, the metal dials, the rugged switch, rheostats, condenser and the simplified control.

Type MA-12
3 Stage R. F. and Detector
$128.00

Type MA-13
3 Stage R.F., Detector and 2 Stages A.F.
$160.00

DEALERS: An attractive proposition is open to dealers in good standing.

Mu-Rad Laboratories, Inc.
801 Fifth Ave. Asbury Park, N. J.



The New Star in the Radio World

They copied all they could copy,
But they could not copy our mind;
We left them tearing and swearing
A thousand miles behind.

KIPLING.

HELP WANTED—RADIO

Radio operators again in big demand. Positions assured to all graduates of this school. Best record of any radio school in the United States as shown by recent check of our graduates receiving first grade commercial licenses. Start any time. For full information, call, phone or write

Y. M. C. A. RADIO SCHOOL
158 East 86th Street New York City
Telephone Lenox 6051
"The Best Radio School in the East"
"A Job for Every Graduate"

FREE for 10 Days' Wear

Send no money—just tell us which ring to send—No. 101, 102 or 103. We will send you one of these genuine sparkling Tifnite gems mounted in solid gold—on 10 days' FREE TRIAL. Don't miss this offer. Send.

Put It Beside a Diamond When it arrives, deposit $3.50 with postmaster. Wear it 10 days. See how beautifulitis. If anyone can tell it from a diamond, send it back and we refund deposit. If you buy, pay the balance at $3.00 per month until $12.50 is paid. Write today. Send strip of paper fitting end to end around finger joint for ring size.

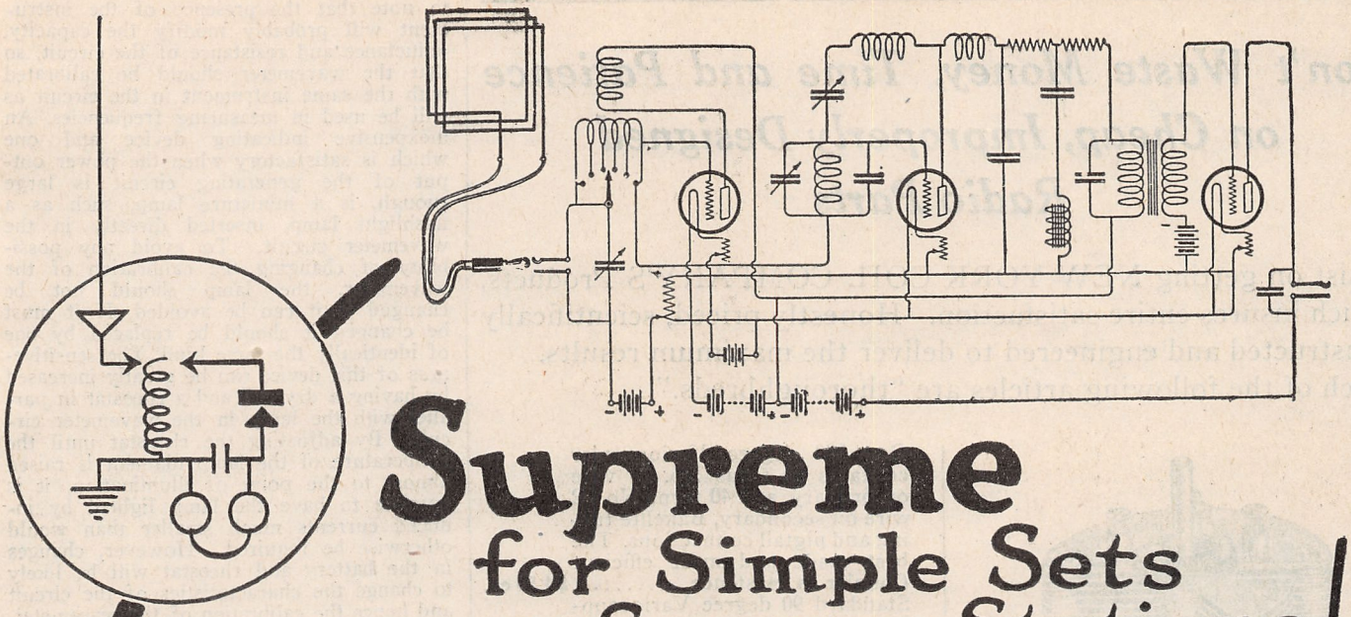
The Tifnite Co., 511 S. Plymouth Ct. Dept. 1315 Chicago

considerable increase in the power losses. Broken strands seriously increase both the effective capacity and the resistance of the coil. The strands may be tested for continuity by dipping one end of the cable in mercury and joining the separate strands at the other end successively to a buzzer or voltmeter joined to a battery, the circuit being closed through the mercury contact. The enamel may be removed from the ends of the separate strands by carefully heating the end of the wire cable to a red heat and dipping it in alcohol. This procedure makes the strands more fragile and consequently particular care must be exercised to avoid breaking them.

A single-layer coil has generally a lower effective capacity than a multilayer coil of the same inductance and radius. This, together with the greater precision with which specifications can be furnished for winding single-layer coils, was the reason for choosing this type of coil in the table already given. Since appreciable effective capacities exist when there are parts of the circuit near each other which have comparatively large areas and which are at different potentials, it follows that the leads from the coil to the condenser should not be long or close together. An additional reason for having the leads short is found in the third requirement previously stated for a wavemeter coil, namely, that the inductance, capacity and resistance of the coil, including its leads, be kept constant. Long leads are apt to be flexible, and flexible leads, long or short, introduce possibilties of change in inductance, capacity and resistance which cannot be compensated for by any slight advantage they may give in convenience of handling. The best leads are rigid metal terminals soldered to the ends of the wire and screwed to the wooden core. The position of the coil should be such that the plane of the turns of the coil is perpendicular to the condenser plates if the condenser is unshielded. This is to prevent the induced current in the coil from itself inducing eddy currents in the condenser plates. Since it is almost always desired for convenience in coupling to have the plane of the coil vertical and the condenser plates horizontal, this matter will usually take care of itself. A very important precaution in giving the coil permanent characteristics is to draw all the turns tight and so fasten them that with ordinary care in handling they will not shift.

The coils may be attached to binding posts on the wavemeter, so that they may be conveniently connected or removed. Various other methods of attaching may also be used.

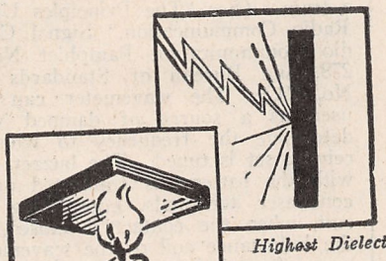
The third part of the wavemeter is the device which shows current flow and thus indicates resonance. If a crystal detector and telephone receivers are used, only the one-point (unilateral) connection should be employed; that is, the detector and telephone receivers are joined in a closed circuit, and one point of this circuit is joined to one terminal of the coil. This arrangement is sufficiently sensitive and makes the calibration of the wavemeter fairly independent of the position of the telephone leads, at least so long as they are not closely drawn across some part of the wavemeter or wrapped around it. A more precise indicating device is a thermogalvanometer or a radio-frequency milliammeter. Available types of thermocouple instruments are usually found more satisfactory than the ordinary expansion type of hot-wire instrument, because they respond more quickly to changes of current. The instrument should give full scale deflection with a current of about 0.1 ampere. It should be able to stand a considerable overload. It is generally inserted directly in the wavemeter circuit, sometimes with a shunt to keep low the resistance of the circuit. It is important



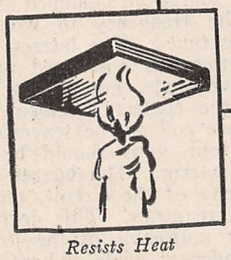
Supreme for Simple Sets or Super—Stations!

The country's foremost radio engineers rely on Bakelite-Dilecto, XX. So do multitudes of amateurs, with their less elaborate or home-made hook-ups.

The astonishing qualities of B-D-X-X make it the *perfect* material for Radio panels, bases, frames and the various insulation requirements.

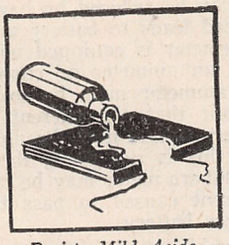


Highest Dielectric

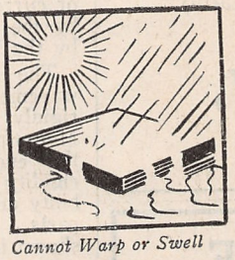


Resists Heat

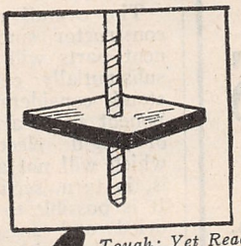
Water Proof



Resists Mild Acids and Solvents



Cannot Warp or Swell



Tough; Yet Readily Machined

bakelite dilecto!!

(A LAMINATED PHENOLIC CONDENSATION PRODUCT)

Uncle Sam has used B-D-X-X in the United States Navy and Signal Corps for over EIGHT YEARS! THAT bespeaks its worth! It proves superior in every test. See the six radio-advantages at the left; an unmatched combination of merits!

Tough as it is, Bakelite-Dilecto is readily machined. Any electrical supply man can get it for you, cut to any size and drilled to your exact specifications. Demand Bakelite-Dilecto, X-X grade, and get highest radio results for all time. Write us for names and addresses of dealers near you.

The Continental Fibre Company

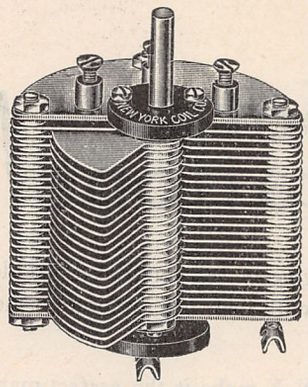
Factory: Newark, Delaware

Dealer service from:

New York	233 Broadway	Pittsburgh	301 Fifth Ave.
Seattle	91 Connecticut St.	San Francisco	75 Fremont St.
Chicago	332 S. Michigan Ave.	Los Angeles	411 S. Main St.

Don't Waste Money, Time and Patience on Cheap, Improperly Designed Radio Parts

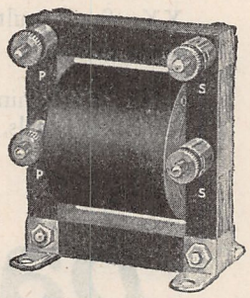
Insist on getting NEW YORK COIL COMPANY'S Products, which insures entire satisfaction. Honestly priced, scientifically constructed and engineered to deliver the maximum results. Each of the following articles are "thoroughbreds."



11 Plate	$1.50
23 Plate	2.00
43 Plate	3.00
3 Plate	1.25

New York Coil Compayn's Variable Condensers have set a standard by which all others are judged. Plates are of extra heavy aluminum, accurately spaced. The frame work of the supporting elements is such that permanency results. Adjustable bearings with provision to take up wear and means for always insuring positive contact is provided.

Our 180 degree Variocoupler contains 50 turns No. 20 wire on primary, and 40 turns No. 22 wire on secondary, Bakelite tubing and pigtail connections. The best made and most efficient Coupler in existence ..... $4.50 ea.
Standard 90 degree Variocoupler ..... 4.00 "
Our Variometers are full size precision instruments ..... 4.00 "
Real Radio Frequency Transformers ..... 4.00 "



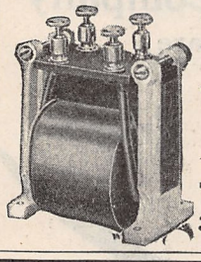
Audio Frequency Transformers—Choice of leading manufacturers and radio engineers. Guaranteed to give high magnification, less distortion and better all round efficiency. No howling. Price $4.00.

THE NEW YORK ENTERTAIN-A-PHONE RECEIVING SET, consisting of Tuner, Detector, and two stages of Amplification, priced at $50.00 is the greatest value ever offered in Radio.

NEW YORK COIL COMPANY,

338 Pearl Street, New York City. N. Y.

Thornton *Audio Frequency* *Amplifying* **Transformer**



"The Transformer Supreme"

We still have territories open for Jobbers
Write for particulars

Thornton Transformer Co., Inc.
30 Church St., New York

BAKELITE
RADIO PARTS
Moulded To Your Design

Northern Industrial Chemical Co.
11 Elkins St. **Boston, Mass.**

Moulders of Electrical Insulation

WHY not spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collection. Some worth $1 to $7 each. Simple outdoor work with my instructions, pictures, price list. Get posted now. Send 10 cents (NOT STAMPS) for my Illustrated Prospectus. Mr. Sinclair, Dealer in Insects, Dept. 37, Ocean Park, California.

THORO-BRED RADIO PRODUCTS
The Marshall-Gerkin Co.
Toledo, Ohio

to note that the presence of the instrument will probably modify the capacity, inductance and resistance of the circuit, so that the wavemeter should be calibrated with the same instrument in the circuit as will be used in measuring frequencies. An inexpensive indicating device and one which is satisfactory when the power output of the generating circuit is large enough, is a miniature lamp, such as a flashlight lamp, inserted directly in the wavemeter circuit. To avoid any possibility of changing the calibration of the wavemeter, the lamp should not be changed if it can be avoided. If it must be changed it should be replaced by one of identically the same kind. The sensitiveness of this device can be greatly increased by having a dry cell and a rheostat in parallel with the lamp in the wavemeter circuit. By adjusting the rheostat until the temperature of the lamp filament is raised almost to the point of illumination, it is possible to have the lamp lighted by induced currents much smaller than would otherwise be required. However, changes in the battery and rheostat will be likely to change the characteristics of the circuit and hence the calibration of the wavemeter. This device should therefore be used with caution.

The wavemeter may be excited by impact, that is, by a source of highly damped waves having only a very few waves in a train. (See "The Principles Underlying Radio Communication," Signal Corps Radio Communication Pamphlet No. 40, p. 278, and Bureau of Standards Circular No. 74.) The wavemeter can then be used as a source of damped waves to determine the frequency to which a receiving set is tuned. The buzzer, in series with the battery, is connected across the condenser terminals, completing its circuit, when the contact is closed, through the inductance coil of the wavemeter. Not more than four volts should be used to operate the buzzer. The buzzer will add to the capacity of the circuit, thereby decreasing its frequency. This decrease will be especially noticeable at the lower part of the condenser scale, where it may amount to several per cent of the frequency. It can be reduced by having short, widely spaced leads to battery and buzzer. If the wavemeter is equipped with both a buzzer and an ammeter or current-square meter, the ammeter must be so connected in the circuit that the current from the buzzer battery cannot pass through the ammeter. If this is not done, the ammeter or current-square meter may be burned out by the current caused to pass through it by the buzzer battery.

The assembling of the parts of the wavemeter must be such that each part is rigidly joined to the rest of the circuit. Mounting in a box is as good a means to this end as any from the standpoint of rigidity and is superior to any in portability and in the protection afforded to the parts. A convenient box mounting is shown in Fig. 1.

The overall dimensions are left to the constructor since the size of the component parts will vary. The box should be substantially constructed so that it will stand considerable handling. The component parts are all mounted on a panel of rigid electrical insulating material which will not absorb moisture. This panel is, in turn, secured to the supporting box. It is possible to use a panel of thoroughly dried and seasoned hardwood which is varnished with an extra grade of insulating varnish. Fig. 1 shows one possible distribution of the component parts. Attention should be given to the convenience of operation and advantageous wiring of the circuit to keep distributed capacities at a low value. The most advantageous arrangement of the instruments on the panel will depend in part on the particular instruments used, and the constructor should

—if you can afford to pay more—you will still prefer CROSLEY efficiency

From the most humble home to the elaborate drawing-room, Crosley Instruments are preferred. Regardless of the many higher priced instruments on the market, the man who knows—even if he can afford to pay more—will choose Crosley.

There is no secret in this. Crosley instruments are the acme of efficiency and simplicity and their construction is based on sound fundamental principles. Numerous tests by disinterested parties all over the country will bear us out in this statement.

If you are a prospective purchaser demand that your dealer demonstrate Crosley Apparatus. He should be able to furnish you with Crosley Instruments. If not, send us his name and order direct.

If you are a Jobber or Dealer and do not already handle Crosley Instruments, you will be wise to satisfy the demand that our national advertising has created.

CROSLEY
BETTER-COST LESS
RADIO

Complete sets from $25 up, all kinds of parts and experimental units.

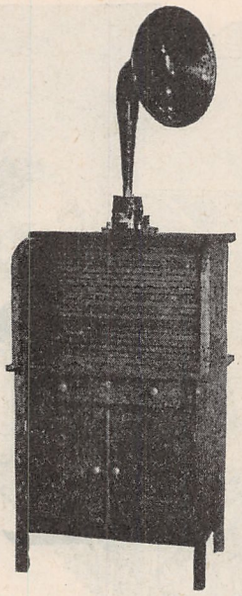
Write for Catalog

Crosley Manufacturing Co.
222 Alfred Street **Cincinnati, Ohio**

CROSLEY RECEIVER MODEL X. A four-tube outfit the same as shown in the above scene. It consists of tuner, one stage of Tuned Radio Frequency Amplification (the feature that has made this set so popular) Detector and two stages of Audio Frequency Amplification in a beautiful mahogany cabinet. It will bring in distant stations loud and clear. With this set, listeners in Florida have heard Winnipeg, San Francisco and Honolulu. Price without phones, batteries or tubes **$55.00**

We Are Manufacturers of Fine Radio Furniture

A Radio Desk De Luxe—the last word in Radio Furniture. A place in which to lock up your Cabinet. A drawer with lock, for your tubes, headset, etc. A Cabinet for concealing storage battery, "B" batteries and rectifier. A broad place on top for loud-speaker.



SPECIFICATIONS

Hardwood, rubbed mahogany or dark golden-oak finish. Roll top with lock. Height over all, 40 inches. Upper Cabinet: 12x12x22 inches. Drawer: 17x9x2 inches. Battery Cabinet: 21x14x13 inches.

PRICES

Express paid east of Mississippi River..... $25 00
Express paid west to Rocky Mt. States..... 27.50
Express paid to Rocky Mt. and Pacific States.. 30 00

CASH WITH ORDER

RADIO TABLES

Handsome Hardwood, hand rubbed, mahogany or golden-oak finish. Drawer with lock, for headset, tubes, etc. (by error not shown in cut.) Ample space for Cabinet on table. Plenty of space for concealing all batteries and rectifier. A beautiful piece of furniture for the home.

Shipped, charges paid, to points east of Mississippi River, west of Mississippi River, add $1.00 to either size.

14¾x24x26 inches high..... $12.00
16½x26x26 inches high..... 15.00

CASH WITH ORDER

RADIO CABINETS

Hardwood, hand rubbed, mahogany finish. Hinged top, front rabetted for panel. Sent postpaid.

THE SOUTHERN TOY COMPANY
HICKORY, NORTH CAROLINA

A Revolutionary Change—

Type A-1

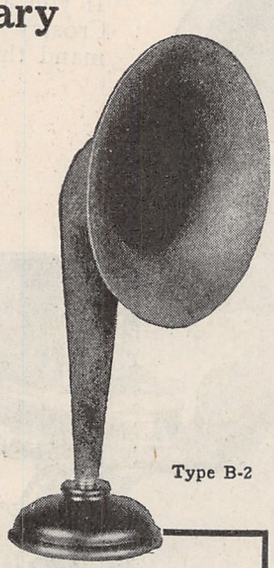
TRUTONE
TRADE MARK

The New Non-Metallic Loud Speaker Supreme

TRUE TO ITS NAME

PATENT PENDING

A Perfect Radio Reproducer



Type B-2

THE TRUTONE Amplifying Radio Horn is scientifically designed in accordance with Acoustic laws, constructed of **Non-Metallic** Seamless Composition with an approved wooden tone chamber in base, which brings out clear resonate trutone values with the maximum of volume. The base of type A-1 is designed for ready reception of both Receivers without removal of Head Band. Phones resting against Soft Rubber Ears, thus blending strength of both into one. Horn and base finished in Black Crystaline Baked Enamel, Nickel Trimmings; 12-inch Bell, stands 24 inches high.

PRICE
$6.50
EITHER TYPE
Sent Postpaid
$7.00 East of Rockies
Dealers: Write for discounts.

The base of Type B-2 is designed for ready reception of any single Receiver, "Baldwin" or others. Horn fits either type base. Price with both bases $8.00. Packed in individual cartons.

Horn Without Base $5.00. Ferrule for Adapting Horn to Magnavox 25c

Manufactured By— **SADLER MANUFACTURING CO.**
86 FOURTH STREET Phone Garfield 1076 SAN FRANCISCO

work out the best arrangement in each case. Fig. 2 gives a circuit diagram showing the connections as they should appear underneath the panel. These connections should be made of No. 12 solid copper wire soldered into lugs. Where bending is necessary, sharp right-angle bends are used. If it is desired to make a short-wave portable receiving set, terminals for antenna and ground connections can be supplied without decreasing the value as a wavemeter in any way, provided suitable care is used in handling the instrument. A wavemeter should be handled much more carefully than an ordinary receiving set. If it is desired to shield the wavemeter, a copper or brass sheet can be permanently fixed on the under side of the panel and spaces cut in it to allow for the terminals and supports of the various units. There should be at least one-eighth of an inch clearance for the terminals. Fig. 3 gives the dimensions and construction of the inductance coils.

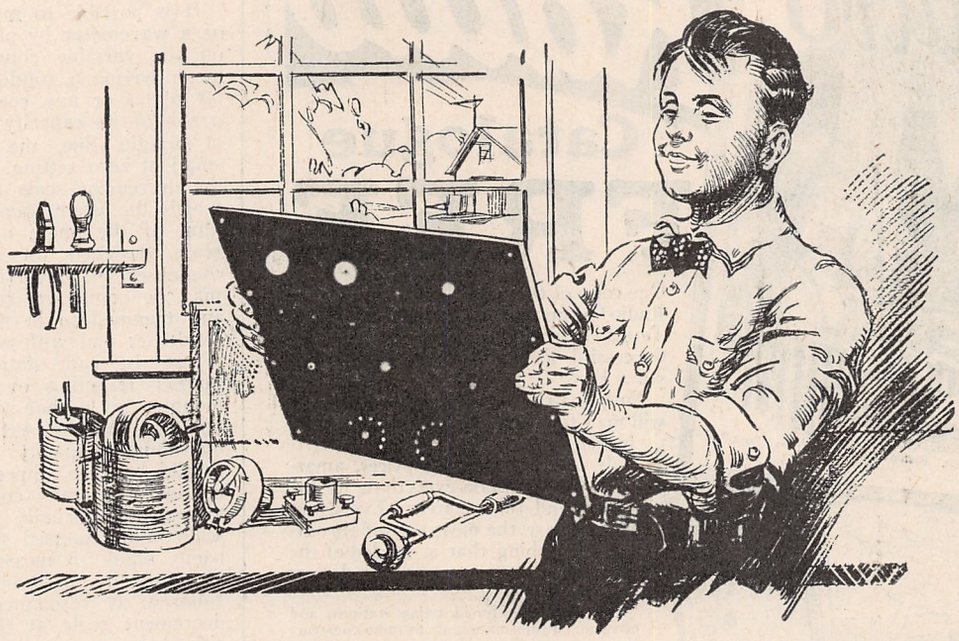
The forms are turned in a lathe from thoroughly seasoned wood. Several coats of extra grade insulating varnish applied to this form will be desirable in keeping low the absorption of moisture. The proper number of turns of the correct size of wire is wound in a single layer in the recess provided for this purpose. A light coat of extra grade insulating varnish is applied to the wire to keep it in place and to prevent moisture from changing the distributed capacity of the coil. The terminals of the inductance coil are brought out through the wood form and soldered to the supporting brass terminals. The wood screws holding the coil form to the brass supports should be of brass rather than a magnetic material.

It is desirable that the box be provided with a protecting cover and a carrying handle.

After the wavemeter has been constructed, it must be calibrated. This service has been done in the past by the Bureau of Standards. It has lately been necessary, however, on account of the limited personnel available for this work, to limit the tests of radio materials made by this Bureau to tests of precision instruments which will in turn be used as standards for testing considerable numbers of other instruments, tests for Government institutions and state universities, and a few other tests for which there is a special reason why they should be undertaken by this Bureau. Standardization of instruments of the kind described in this Circular can be obtained from various commercial firms and some college and university laboratories.

Consideration has been given to the transmission of standard wave-length signals from laboratories equipped with precision measuring apparatus. This would make it possible to determine accurately several points on the calibration curve of a wavemeter without sending it to a standardizing laboratory. The carrier waves of some radio telephone broadcasting stations may be adusted to some particular wave, such as 360 meters, and one point on a wave-length calibration can thus be determined. A wavemeter transported for standardization should be packed in a wooden box large enough to give room for three inches of excelsior on every side. otherwise the wavemeter may easily receive internal damage which will not appear except in its subsequent behavior. The package should be marked "Scientific Instrument. Handle with Care."

Two cautions are offered as to the use of the finished and standardized wavemeter. The first is, not to subject the instrument to any treatment apt to change its calibration. The second is not to couple it too closely to the source of the radio-frequency current which is being measured. The latter error can be avoided by



This Panel Will Improve Your Set

CONDENSITE CELORON

The best panel made is none too good for your set. Dependable insulation is vital because it has a direct bearing upon the clearness and sensitivity of both transmission and reception.

Every thinking radio enthusiast certainly wants the highest type panel he can obtain and the surest way to get it is to insist upon Condensite Celoron.

This strong, handsome, jet-black material is not merely an insulating material—it is a radio insulation made to meet high voltages at radio frequencies. That is why it will give you greater resistivity and a higher dielectric strength than you will ever need.

Make your next panel of Condensite Celoron. It machines readily, engraves with clean-cut characters and takes a beautiful polish or a rich dull-mat surface.

An Opportunity for Radio Dealers

Condensite Celoron Radio Panels and Parts offer a clean-cut opportunity to the dealer who is keen on building business on a quality basis. Write us today. Let us send you the facts. You'll be interested.

DIAMOND STATE FIBRE COMPANY

BRIDGEPORT (near Philadelphia), PA. Branch Factory and Warehouse, Chicago

Offices in principal cities

In Canada: Diamond State Fibre Co. of Canada, Ltd., Toronto

Radio Catalogue FREE

One copy of this complete Catalogue of Radio Outfits, parts, Dictionary of Radio Terms, Instruction Book, and Guide to Successful Radio Work — one copy is yours Free.

Simply write us a post card and we will mail the complete book to you Free, by return mail.

It quotes the lowest prices, amazingly low prices on everything for the expert and the amateur. Every improved part, the most up-to-date outfits, everything that is needed of the most modern type — at the lowest possible prices.

It gives a list of broadcasting stations, and gives much information about radio construction and operation. Every one interested in Radio needs this complete catalogue and book of instruction.

Why Pay Higher Prices?

Montgomery Ward & Co. has for fifty years dealt on a Money-Back basis, absolutely guaranteeing everything they sell. With quality absolutely assured, why pay higher prices elsewhere? Write today for this Free Radio Book and see for yourself the Saving it will bring you.

One copy is yours Free. You need only write us a post card.

Write to the house nearest you. Address Dept. 2-R

Chicago Kansas City St. Paul Fort Worth Portland, Ore.

Montgomery Ward & Co.

The Oldest Mail Order House is Today the Most Progressive

"ILLINOIS" THE RELIABLE

CONDENSER THAT IS MADE RIGHT AND STAYS RIGHT

	Panel	Cased		Panel	Cased
67 Plates.....	$7.00	$8.50	23 Plates.....	$2.75	$4.00
43 Plates.....	3.50	4.75	13 Plates.....	2.25	3.50

Vernier with single movable plate applied to 13, 23 or 43 sizes, $2.00 extra.

Above list is for our Regular Style with Knob, Pointer and Scale. We also furnish the Condenser with smooth 3-16 inch staff suitable for Dial at 15c off list.

A 3-inch Bakelite Dial with Condenser, add 50c to list.

Fully Assembled and Tested. IMMEDIATE SHIPMENT.

Money back if not satisfied. Just return within 10 days by insured Parcel Post.

Sent Prepaid on Receipt of Price, Except: Pacific States, Alaska, Hawaii, Philippines and Canal Zone, add 10c. Canada, add 25c.

No Discounts except 5 per cent on orders of 6 or more. Send for Bulletin.

G. F. JOHNSON. 625 Black Ave., Springfield, Ill.

ROLLER SMITH

QUALITY PRODUCTS

Instruments
Loud Speakers
'Phones

Send for Bulletins V-10 and V-20.

Roller-Smith Co., 15 Barclay St., N. Y.

Works: Bethlehem, Penna.

Offices in Principal Cities in United States and Canada

NICK'S RADIO BARGAINS

VARIOMETERS (150 to 600 Meters)	$2.74
COUPLERS (150 to 600 Meters)	2.43
43 PLATE VARIABLE CONDENSERS	2.56
23 PLATE, $1.91 11 PLATE	1.70

The return of these instruments gladly accepted if not satisfactory

Note—The Radio News would not insert this ad if we handled UNSATISFACTORY MERCHANDISE

NICK'S RADIO SHOP

26 N. Desplaines Street Chicago, Ill

never having the wavemeter so close to this source that it cannot be brought closer without changing the setting for resonance.

It is possible to make a decremeter out of a wavemeter by placing a suitable scale on the variable condenser. For a wavemeter having a condenser with semi-circular plates or any condenser such that the graph of its capacity against its setting is a straight line, the capacity being very small at zero setting, it can be shown that the decrement scale to be used is one in which the graduations vary as the logarithm of the angle of rotation.* Such a scale, designed for a semi-circular plate condenser, is shown in Fig. 2. This scale may be copied or cut from this circular and trimmed to fit the dimensions of the condenser dial with which it is to be used. It may be made stationary with a moving pointer traveling over it, or it may be mounted on a dial rotating under a fixed pointer. At the setting corresponding to maximum capacity the scale reading should be zero. Since the scales of most condensers read counter-clockwise, this arrangement usually places the decrement scale in the unused space opposite the capacity scale. A measurement of decrement is made by first observing the current squared at resonance, then reading the decrement scale at the settings on either side of resonance where the current squared has one-half its value at resonance. The scale is so constructed that the difference between these two readings is equal to $\delta' + \delta$, that is, the decrement of the transmitting circuit plus the decrement of the wavemeter itself. It is then necessary to subtract the wavemeter decrement from the total just obtained. The decrement of the wavemeter is determined as follows: The wavemeter is coupled and tuned to a source of unmodulated continuous waves. The sum $\delta' + \delta$, is measured as just described. Since the waves are continuous, δ, the decrement of the waves is zero, and the result obtained is δ', the decrement of the wavemeter alone. From determinations of the decrement of the wavemeter made at different points on the scale, the calibration curve of decrement plotted against condenser setting is obtained. The conditions necessary to permit the use of this scale in the manner described are as follows:

(1) The condenser must have semi-circular plates. Condensers with plates of a different pattern will have different decrement scales just as they have different capacity calibrations.

(2) It must be remembered that only when resonance is indicated by a current-square meter is the deflection to be reduced to one-half its maximum value in detuning to either side of resonance. If a milliammeter is used, the reading must be reduced not to one-half its maximum value, but to the maximum value divided by the square root of 2 or to 0.71 of the maximum value.

(3) The generator must have an output sufficiently large that the coupling employed may be loose enough to prevent any considerable reaction of the wavemeter on the generator.

(4) Neither the generator nor its coupling with the wavemeter must be changed during the measurement of decrement.

The following precaution is to be observed in measuring the decrement of a transmitting station. The decremeter must

*J. H. Dellinger. Measurements of radio-frequency resistance, phase difference and decrement, Proc. I. R. E., vol. 7, pp. 27-61, Feb., 1919. Circular 74 of the Bureau of Standards, Radio Instruments and Measurements, p. 197.

PERFECT ELECTRIC CONTROL

RESIST-O-METER

TRADE MARK

"Better than a Rheostat"

With adjustable brackets for mounting in old screw holes

At last! Perfect Control

Type A—Filament
(Twice actual size)
Price $1.80

We manufacture the following:

RESIST-O-METERS
Type A—Filament
Type B—"B" Battery
Type C—Potentiometer

TEST-RITE CONDENSERS
in the following capacities:

Phone	.001	mfd.
Grid	.00025	"
Grid	.0005	"
Grid Leak	.0005	" 1-meg.

V.T. Sockets
Engraved Binding Posts
Accessories

WHEREVER you find a radio set with a Resist-O-Meter you will find an operator who at last has secured a really satisfactory variable resistance.

The Resist-O-Meter is a remarkably simple device, and inexpensive, yet gives the infinite variation in resistance so necessary to perfect electrical control.

The results speak for themselves.

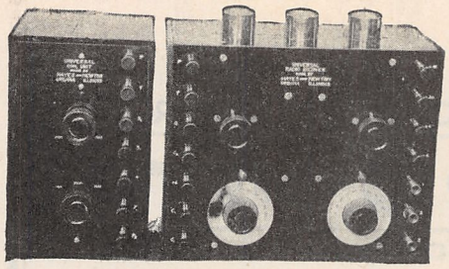
The "Resist-O-Meter"—a Scholes Product

—is a micrometer control and gives continuous variation between the extreme ranges of its ohmage,
—is non-microphonic,
—is supplied with adjustable brackets for mounting, making new screw holes in panel unnecessary,
—is compact and convenient, and takes up very little space in standardized mounting,
—is made in models covering every requirement for radio use,
—possesses the lowest resistance at full compression (practically zero),
—the resistance material cannot pack.

The Scholes Radio & Manufacturing Corporation holds the sole license to manufacture this type of current control, under patents granted Mr. F. A. Rojas, Nos. 15478 and 1366945, other patents pending. It is sold only under trade name "Resist-O-Meter." Ask your dealer to supply you.

Write to Mr. H. L. Demuth

The Scholes Radio & Manufacturing Corporation
32-36 West 18th Street New York City



The biggest advance yet made toward elimination of distorted signals is found in the "Universal Radio Receiver and Coil Unit."

This set has been designed to cover all the fine points of radio technique.

The wave length range possible with Coil Unit is 180 to 6200 meters. The Universal Radio Receiver is exceptionally well adapted for reception of Radio telephone and all classes of Radio telegraph and continuous wave signals.

The Receiver is equipped with detector and two-stage audio frequency amplifier all mounted in one cabinet, while the Coil Unit is in a separate cabinet.

The total amplification of received signals is greater than 2000 times as strong as if received over a crystal set. The Universal Radio Receiver makes use of a device to PREVENT DISTORTION which, in effect, operates as a permanent "C" battery. The set will always operate at its maximum efficiency and SIGNALS WILL ALWAYS BE CLEAR AND INTELLIGENT.

FINE TUNING OF THE SET is accomplished by means of the VARIABLE CONDENSERS, thus giving an extremely large wave length variation.

BAND WOUND COILS, which is the best known form of winding, are used throughout.

The terminals of the various circuits are brought out to binding posts which allows the use of any of the following standard hook-ups: single circuit, two circuit, regenerative, or oscillating.

The cabinets are mahogany with bakelite panels.

Dimensions of Universal Coil Unit, 5¾" x 9¼" x 4¼".

Size of Universal Radio Receiver, 11½" x 9¼" x ¼".

We guarantee the workmanship and quality of this set to be of the highest type.

Dealers write for our proposition. The demand for this set will be tremendous everywhere. A simple demonstration will bring all the orders you can handle.

Price $110.00 F.O.B. Factory

HAYES and NEWTON

115 North Market **Urbana, Illinois**

TradeMark

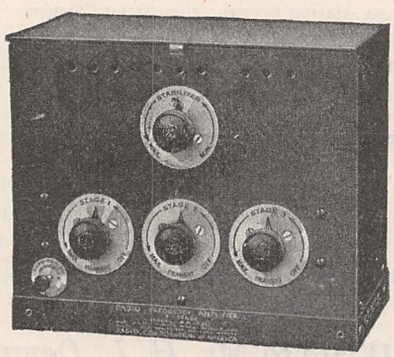
THE SYMBOL OF SERVICE

CONTINENTAL

"New York's Leading Radio House"

RADIOLA MODEL AA-1520
3-STAGE RADIO FREQUENCY AMPLIFIFR

Radiola AA.-1520 is a radio frequency amplifier especially designed to operate without the use of an outdoor antenna. When used with the detector amplifier model AA.-1400, Loop Antenna AG.-1380, Tuning Condenser AC.-1820, and Vocarola loud speaker broadcasted programs for many miles, may be successfully received. Sectional models AA.-1520 and AA.-1400, may be combined into a single unit by trays placed top and bottom. Radiola AA.-1520 Three Stage Radio Frequency Amplifier retails for $80.00. Tray and Cover to accommodate two units, per pair, $2.50.



"Modern Radio"—A two hundred and eight page catalog of our wireless equipment, supplies and apparatus sent for twenty-five cents.

2021-Q

CONTINENTAL RADIO *and* ELECTRIC CORPORATION

SIX *and* FIFTEEN WARREN STREET, NEW YORK, U. S.

be coupled only to the antenna circuit to be measured, not to the primary circuit; consequently it should be kept not less than two meters away from the oscillation transformer, and coupling to the antenna circuit should be obtained by placing the decremeter near the antenna or ground lead, preferably the latter. If the antenna current is small, it will be necessary to make a single turn of small diameter in the lead to which the decremeter is coupled.

The following articles are of interest in connection with the construction of simple wavemeters:

Cox, R. T., and Kruse, S., Portable wavemeters for short-wave radio, *QST*, 5, 14, Sept., 1921.

Sleeper, M. B., A wavemeter for radio experimenters, *Everyday Engineering*, 7, pp. 357-359, Sept., 1919.

Sleeper, M. B., A heterodyne wavemeter for 170 to 21,000 meters, *Everyday Engineering*, 9, 247-250, June, 1920.

Lacault, R. E., How to make and use a wavemeter for short wave lengths, *Radio News*, 3, 384-385, Nov., 1921.

Wavemeters. *Wireless Age*, 9, 36-41, Nov., 1921.

Goddard, R. W., Heterodyne wavemeters, *Wireless Age*, 7, 15-17, Feb., 1920.

Clemons, D. R., A practical 50-5000 meter wavemeter, *Radio News*, 3, 939, April-May, 1922.

Kent, A. D., The design and construction of a continuous-wave wavemeter, *Wireless World*, 8, 6-12, April, 1920.

Atkinson, Cyril T., The construction of a continuous-wave wavemeter, with special reference to heterodyne reception, *Wireless World*, 9, 444-447, Oct. 15, 1921.

Ballhatchet, A. V., A wavemeter, Model Engineer, 44, 89-91, Feb. 3, 1921, *Radio Review*, 2, 217 April, 1921.

Pacent, L. G., Wavemeter construction and operation, *QST*, 3, 8-10, December, 1919.

A Five-Watt Telephone and Modulated C. W. Transmitter

(*Continued from page* 1478)

little experimentation or trial will soon show what values of resistance are best. It will generally be found that 10,000 ohms is about the maximum, and intermediate values of 7,000 to 10,000 may yield better results. This is a matter determined by trial and the constructor should experiment with different values of capacity and resistance until the best combination is found.

The modulation circuit as used in this set is shown in Fig. 7 in conjunction with the oscillating circuit. The audio frequency choke coil Lc for best modulation should have a reactance equal to the resistance of the modulator valve, and in the five-watt tubes this resistance is between 4,000 and 5,000 ohms. To secure this reactance for the very lowest speech frequencies, it will be necessary to have a choke coil of about eight henries inductance. The best type of choke coil is an open core type; never use the closed core as there may be considerable distortion due to saturation produced by the direct current to the plate. An iron core having a cross section of about 2½ to 3 square inches and about 5" long should be built of laminated steel sheets, No. 29 standard U. S. gauge, and stacked up until the proper section is secured. This should be insulated either with paper or linen tape and wound with about 5,000 turns of No. 28 enamel wire.

The microphone transformer depends largely upon the type of microphone used.

GRAND OPERA!

Catalog Number Four contains Marvelous article on tuning Receiving Sets Ten cents brings it to you

There is a nightly performance of Grand Opera. Let Tuska Reliable Radio take you, together with home comforts.

Tuska Quality Radio Apparatus is reliable in service, moderate in price.

Ask for Tuska Radio at your dealers today.

The C. D. Tuska Company
44 Bartholomew Ave.
Hartford, Connecticut

TUSKA RADIO

Established 1911

MOON
LOUD SPEAKER

It Sells by Sound!

Splendid tone qualities account for the MOON'S great popularity. See it and you'll like it. Hear it and you'll be surprised. Clear tones, resonant and sonorous.

Made Right

Extra heavy aluminum highly polished. Seamless horn. Spun like silverware; in one piece. Horn turns in socket any direction without moving base. Height 15½ inches.

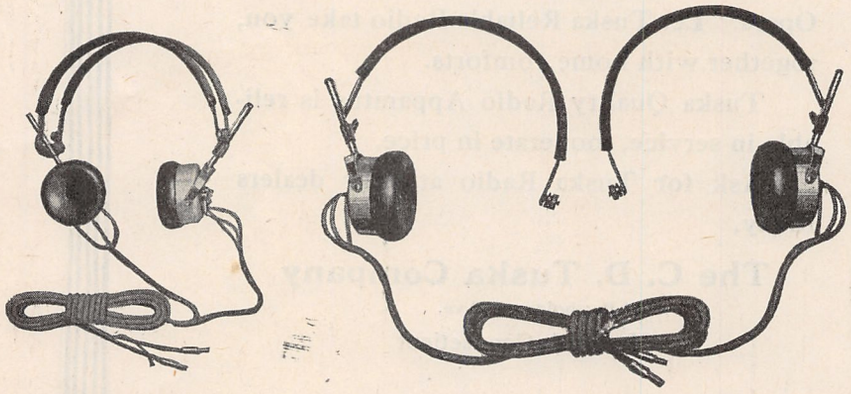
Ask your dealer for a demonstration

Only $7.50

Low list price

Liberal dealer discounts

Wilson Utensil Co.
440 East Third Street,
DAYTON, OHIO



10-DAY *Premier Duplex* TRIAL

QUALITY PHONES
PAT. APLD. FOR

Premier Duplex Phones give real satisfaction. They increase the efficiency of receiving sets and add to the pleasure of listening in. The tone is clear, loud and pleasing. The caps feel good on your ears.

The best of materials, such as Tungsten Steel Magnets, Norway Iron Core, Commercially Pure Copper Wire Coils all carefully assembled and neatly finished make the Premier Duplex Phone one of the best.

The band splits into two parts, each having an overhead strip. It is very convenient for two persons to use. The adjustment is simple and effective. The cord permits of a five-foot separation between phones.

$6.50 for 2000 Ohms **$8.00 for 3000 Ohms**

Premier Accessory and Specialty Corp.
25 CONGRESS STREET
NEWARK, N. J.

A good stable type of microphone is No. 284-W, which will be fuond to be quite reliable. The transformer should have a turns ratio of approximately 25 to 1 or 30 to 1. There are some very good transformers on the market which are just suitable for this type of work, and also have side tone windings which enable the operator to listen in on his speech and check his operation. The specifications of a 30 to 1 transformer which will give satisfactory results are as follows: The core consists of a bundle of iron wires stacked to give a diameter of about ½" or it may consist of silicon steel laminations ½" x ½"x4", each lamination to be shallacked on one side. The primary consists of 180 turns of No. 20 D.C.C. and the secondary of 5,400 turns of No. 36 enamel wire. The core, it will be observed, is an open core, which is again preferable to the closed core for reasons of possible distortion due to saturation.

It is suggested that the grid of the modulator be biased with a negative potential by means of a "C" battery. The best potential can only be obtained by trial, although an average potential is such as to give a modulator plate current equal to that of the oscillator when operating; This can be best ascertained by trial.

In order to permit any by-passing any radio frequency which may get to the generator terminals, a generator condenser C should be used in parallel with the plate source of potential. This generator should have a low reactance for radio frequencies and hence should have a high capacity. Values above 0.1 mfd. will be found suitable.

Radio Patents

(*Continued from page* 1483)

and by providing a microphone and telephone in this line an engineer or operator at the wireless station is enabled to supervise the working. Thus he can listen in to signals received from wireless receiver or land line and can also operate the wireless transmitter through the bridge.

In the accompanying diagram A, B, C, D is a bridge, two arms, A and B, including the secondary windings A′ and B′ of two similar transformers, the winding preferably being of high inductance.

R and R′ are resistances included in arms A and B for purposes of balancing. In the other arms C and D are two impedances, such as condensers C′ and D′, one or both being variable; they may conveniently be air condensers of the kind used in wireless telegraph receivers.

To the primary winding A″ of the transformer in arm A, which primary winding should be of the same order of inductance and resistance as the transformers usually associated with land telephone lines, is connected a land telephone line E to a telephone exchange or subscriber.

To the primary winding B″ of the transformer in arm B is connected an artificial telephone line F which may be adjustable and of magnitude suitable to balance the effect of the land line 1. To this artificial line may be connected an ordinary land telephone subscriber's set G or a microphone and telephone of any suitable pattern.

The junction H of arms A and B and the junction J of arms C and D are connected by leads, which may be screened in metal casing, to the receiver of a wireless telephone set with the addition of any magnifiers required to bring the strength of received signals to a value sufficient to be heard at the subscriber's instrument in the line E.

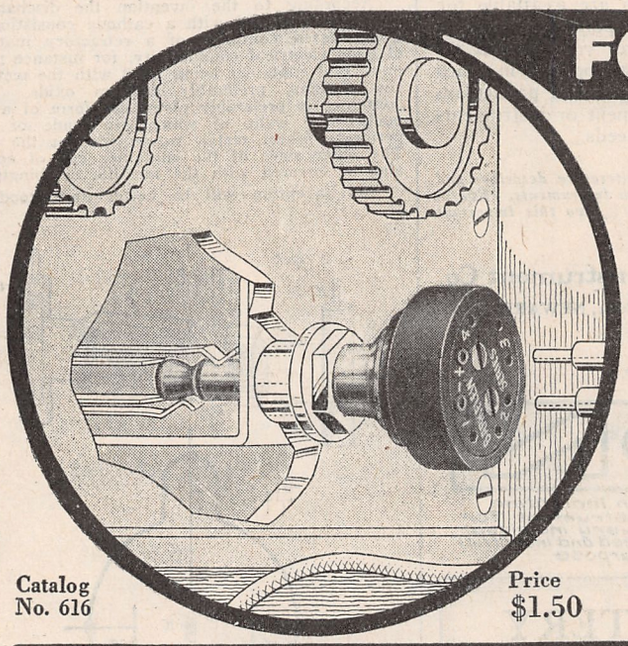
The junctions K of arms A and C, and L of arms B and D, are joined by leads, which may be screened by metal casing, to that circuit of the wireless telephone transmitter usually associated with the microphone, with the addition of any magnifiers required to bring the intensity of speech received from the land line to a value suitable for actuating the wireless telephone transmitter.

Resistances M N and condenser O may be provided to join one diagonal, say K L, of the bridge, and a point between M and N may be

BARKELEW

For simplicity of design, good appearance and low cost these two connectors are in a class by themselves. By means of one or the other you can attach from one to four head sets to any type of radio receiving set. On both of them the phone tips enter from the front and therefore do not increase the diameter, which with all tips adjusted is but 1¼ inches.

FOUR-PHONE PLUG



Catalog No. 616

Price $1.50

This Improved Four Phone Plug with series connection and insulated case will connect four phones or less to any set employing telephone jacks.

The holes with bosses are the terminals of the Plug. For one head set use these holes only. For more than one head set start with one bossed hole and use the holes consecutively but always carry the last phone tip back to the other bossed hole. For four phones all holes will be used.

There is ample room for all the phone tips and they can be adjusted without removing the plug. The tips are held by a special spring contact which we have developed for this purpose.

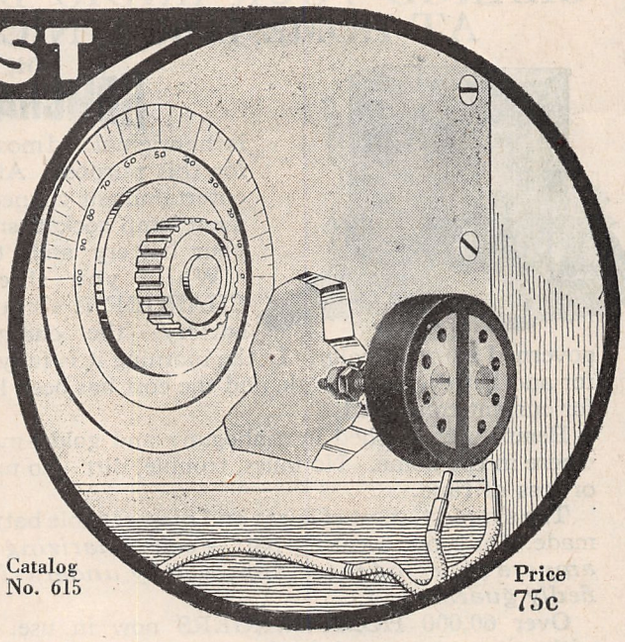
FOUR-PHONE POST

On any radio set, using crystal or one tube detection, that is any set where telephone jack is not employed, the Four-Phone Binding Post should be used. This admits of your attaching from one to four head-sets.

It is built for panel mounting, but not necessarily confined to this type. It is equally adaptable to any home-made set. It replaces or may be hooked in multiple with the regular phone binding posts.

One phone tip goes on each side of the insulating bar. The tips are held by a special spring contact which we have developed for this purpose.

It is normally made with multiple connection but can be furnished with series connection on special order.



Catalog No. 615

Price 75c

To Radio Distributors and Dealers

Trade discounts to Radio Distributors and Dealers who have established standing or can prove their status.

Write for our new Window Display Cards featuring our Four-Phone Plug. Bulletins, No. 27, No. 28, No. 29, and No. 30, showing these and other Radio apparatus will be furnished on request.

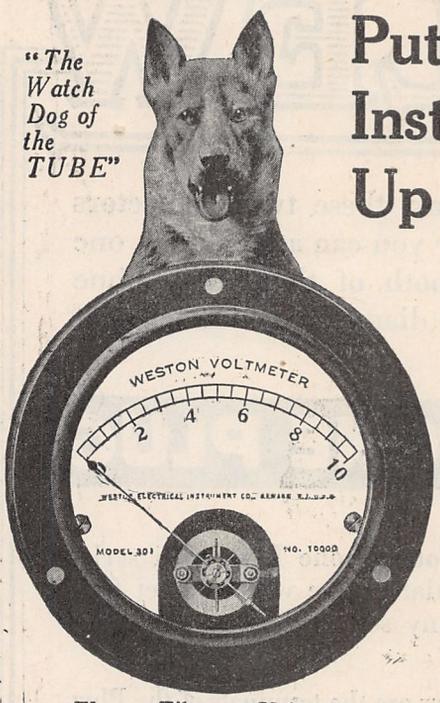
Try your dealer; if he cannot furnish, write nearest office for name of one who will.

The Barkelew Electric Mfg. Co.

MIDDLETOWN, OHIO

15 S. Clinton St., Chicago
75 Fremont St., San Francisco
411 Main St., Los Angeles
603 Century Bldg., Pittsburgh
1487 Broadway, New York
Denham Bldg., Denver

"The Watch Dog of the TUBE"



Weston Filament Voltmeter.

Put YOUR Electrical Instrument Problems Up to WESTON

THERE is a Weston Indicating Instrument to meet every Radio need whether it be for Reception or Transmission. Voltmeters, Ammeters, Milliammeters, Thermo-Ammeters and Thermo-Galvanometers, in low or high range or in small or large size are available for the amateur, advanced experimeter or commercial station. Whatever your special requirement or problem may be, get in touch with us and let us send you full particulars and prices on the instrument or instruments exactly suitable to your needs.

Booklet J, and other Radio literature describes and illustrates these various Weson Instruments. Everyone interested in Radio should have this important data. Write for it today.

Weston Electrical Instrument Co.

173 Weston Ave., Waverly Park, NEWARK, N. J.

Electrical Indicating Instrument Authorities since 1888.

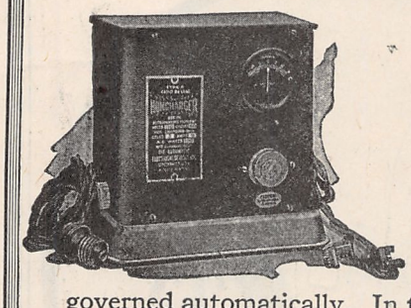
WESTON

"THE SUN NEVER SETS ON THE WESTON"

"STANDARD" THE WORLD OVER ELECTRICAL INSTRUMENTS

An Indicating Instrument for Every Individual Need and Industrial Purpose

CHARGE YOUR RADIO BATTERY AT HOME FOR A NICKEL



THE HOMCHARGER

is the original and most popular charger for this purpose. After an evening's entertainment connect to any convenient lamp socket, snap the clips on your battery and "turn in."

While you sleep the HOMCHARGER is silently charging your battery—the charging rate being governed automatically. In the morning it is fully charged—ready for another evening's work, and the cost has been less than a nickel for current consumed.

Beautifully finished in mahogany and gold—may be used anywhere in the home. No muss, trouble, dirt—no moving of battery or loss of time.

The simplest, most efficient and most reliable battery charger ever made. Only one wearing part—*self-polarizing—five to eight ampere charging rate—approved by underwriters—unqualifiedly guaranteed.*

Over 60,000 HOMCHARGERS now in use. Sold complete with ammeter, etc., by all good radio and electrical dealers for $18.50—no extras to buy.

See the RADIO HOMCHARGER DE LUXE at your dealer's or write direct for our free circular showing why the HOMCHARGER is the best rectifier built at any price.

MOTORISTS The HOMCHARGER will also charge your Auto battery.

THE AUTOMATIC ELECTRICAL DEVICES COMPANY

118 WEST THIRD STREET, - CINCINNATI, OHIO

- Largest Manufacturers of Vibrating Rectifiers in The World -

brought to earth potential or some suitable potential with reference to the wireless telephone set.

ELECTRIC DISCHARGING TUBE

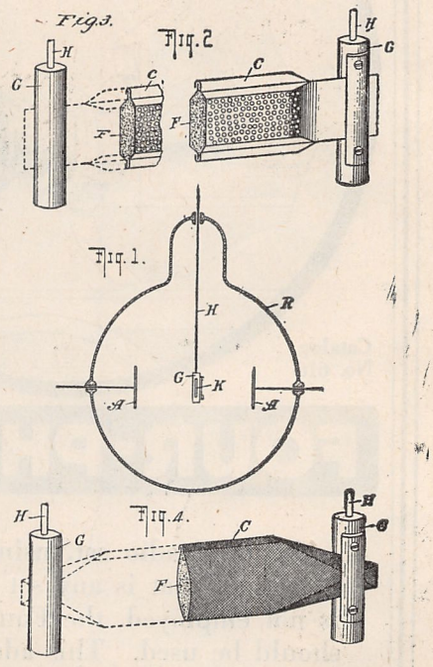
(Patent 1,416,623. Issued to Bruno Donath, of Friedenau, Germany, March 16, 1922.)

This invention relates to electric discharging tubes with incandescent cathode, the latter being covered with any desired metallic combinations according to Prof. Wehnelt's process (described in the German Patent No. 157,845). The object of the improvement is to increase the durability of the said cathodes.

The smooth or rough cathode of the known discharging tubes have hitherto been provided with a thin covering of any desired metallic combination, preferably calcium oxide. They were not very durable as a constant, although small consumption of the oxide takes place in the working cathodes. A thick layer of oxide would be liable to scale off, to heat irregularly and to produce a high ohmic resistance in the discharging circuit.

According to the invention the discharging tubes are provided with a cathode consisting of a perforated container of a refractory material of good electrical conductivity, for instance platinum, said container being filled with the metallic combinations, preferably calcium oxide. The container is preferably given the form of a flat pocket the walls of which are made of thin perforated sheet metal, woven wire or the like. The outer sides of the container can of course also be covered with the metallic combinations.

My invention will be better understood by



referring to the accompanying drawing in which Fig. 1 represents a central diagrammatic section, taken transversely to the cathode, through a discharge tube having a cathode according to my invention; Fig. 2 is a perspective view, partly in section, on an enlarged scale, showing one end of the cathode of Fig. 1 when the container is made of sheet metal; Fig. 3 is a view showing one end of a modified cathode as in Fig. 1; and Fig. 4 is a view, similar to Fig. 2, showing the cathode when the container is made of woven wire.

In the drawings the bulb R is provided with anodes A and a cathode K; the latter is, in the examples shown, held in clamps G which are themselves supported on conductors H.

In Fig. 2 the cathode container C consists of two strips of sheet metal which have been suitably shaped and united so as to provide an elongated receptacle the sides of which are perforated. The two strips are united at their ends so as to fit into the clamps G. (Only one end of the cathode and one clamp are shown.) The receptacle is filled with the desired metallic combination, preferably calcium oxide.

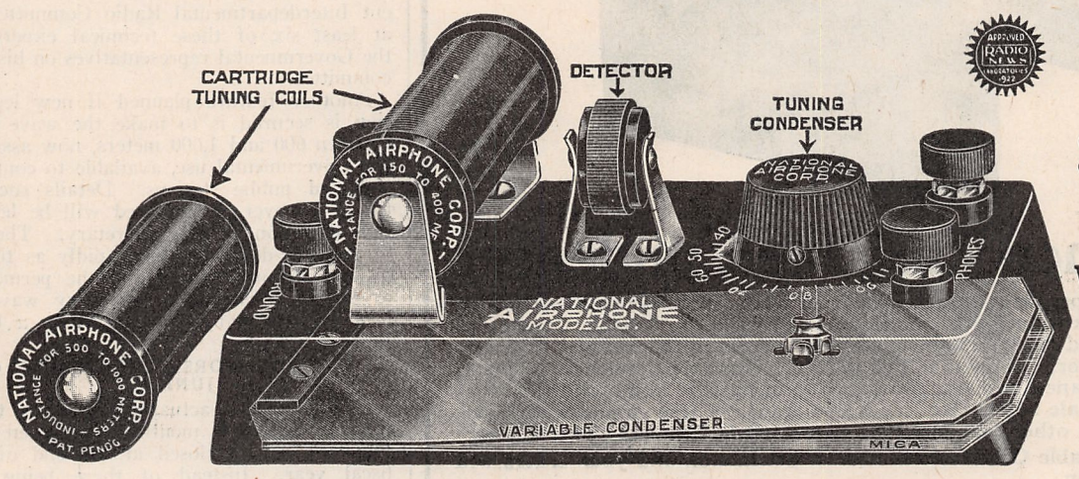
In Fig. 4 the cathode container consists of a strip of woven wire bent or rolled so as to constitute a receptacle of flattened cross section which is filled, as before, with the metallic combination F. The ends are folded and pressed flat so as to close the receptacle and to fit the clamps G.

In Fig. 3 is shown one end of a short section of the container as it appears when the metallic combination is placed upon its outside as well as contained within it.

The conductors H serve to conduct both heat and electric current.

NATIONAL AIRPHONE PRODUCTS

Pronounced by Experts to Be the Greatest Radiophone Crystal Outfit Ever Produced. Awarded the Certificate of Merit by the "Radio News Laboratories," N. Y. Tribune Institute, N. Y. Evening Mail Institute.



$12.50

Without Phones

Patents Pending

NATIONAL AIRPHONE

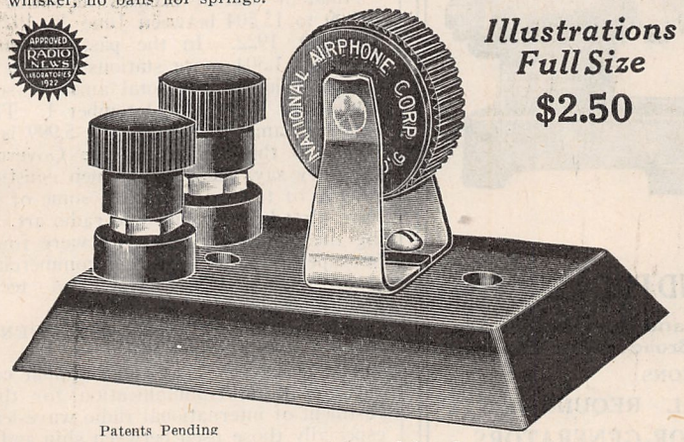
(MODEL G)

Endorsed by Engineers as the Greatest Radiophone Ever Seen or Heard

To operate simply connect aerial, ground and head-phones. Will receive radio broadcast entertainments and commercial reports within a radius of 25 miles; Code signals 1000 miles and over depending upon coils used.

OUTSTANDING POINTS OF SUPERIORITY:

1. Most Compact Radiophone Receiving Set Made.
2. Rugged construction throughout, nothing to get out of order.
3. Entire casing constructed of hard rubber composition. No wood, no warping, no losses through leakage.
4. Ultra-sensitive Foolproof Detector; entirely enclosed in composition case. Air and dustproof, no fussy minerals, no Cat-whisker, no balls nor springs.
5. Use of interchangeable cartridge tuning coils gives wide range over which radiophone broadcast or radio telegraph signals can be heard. 25 miles or over for radiophone concerts; up to 1000 miles for telegraph signals depending upon coils used.
6. Two Cartridge tuners, supplied with each outfit; one takes in general broadcasting stations 150 to 400 meters, the other ranges from 500 to 1000 meters.
7. Variable Mica Condenser used in acme of simplicity—high capacity, impossible to short-circuit.



Illustrations Full Size

$2.50

Patents Pending

GOLD GRAIN DETECTOR

FOR PANEL MOUNTING

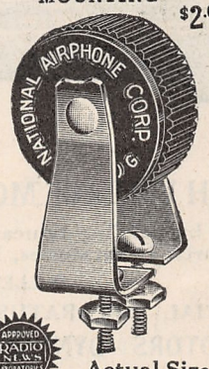
$2.00

After you have fussed with catwhiskers, springs, balls and adjustment handles, and after you have almost become a nervous wreck, hunting for "the elusive sensitive spot"—you will welcome with open arms our 100 per cent. **GOLD GRAIN DETECTOR.**

This Detector has no catwhiskers, no springs, no balls, no adjusting handles; no fussing; 100 per cent foolproof. The Detector is entirely enclosed in hard rubber composition cartridge, but it is NOT a fixed detector.

A special crystal is used, while contact elements are made of pure gold. There is always a multiplicity of contacts. The Detector is sealed hermetically. The contact with the crystal is always perfect.

Due to these revolutionary improvements, this Detector has been pronounced by experts to bring in signals and sounds louder than any other detector on the market. You will be surprised at the great volume of sound you are able to obtain with the **GOLD GRAIN DETECTOR.**



Actual Size

You are protected by this Guarantee:

Should any National Airphone Gold Grain Detector not be in first-class condition when purchased and within five days you return it to us unbroken, or unopened, we will refund your money or give you another one as you may prefer. Or if at any time within a year one should become defective or unsatisfactory to you we will take it back if unbroken or unopened and give you another in its place.

—SEND NO MONEY—

COUPON R.N. 2

National Airphone Corporation,
18 Hudson Street, New York City, N. Y.
Gentlemen:

Please send me prepaid ..... for which I will pay the postman the amount advertised on this page.

If within five days I do not find the apparatus all you claim for it, or if for any reason I am not satisfied, I may return same to you in good condition and you will refund the full purchase price.

NAME .....
STREET AND NO. .....
CITY .....STATE.....

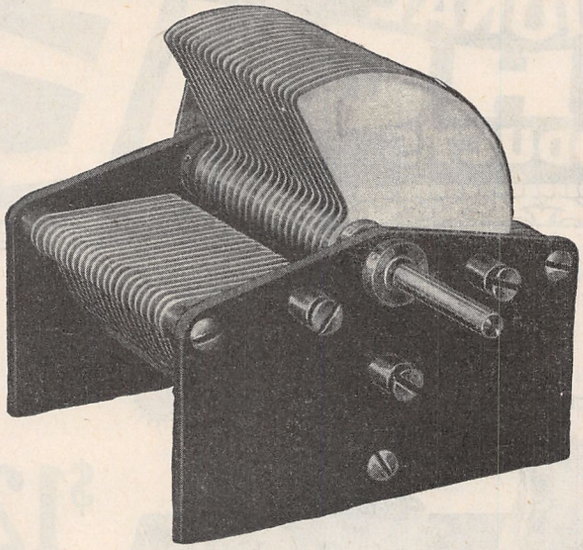
***Distributors*--Write for Exclusive Territory**

***Jobbers and Dealers*--Send for Price List**

NATIONAL AIRPHONE CORPORATION

18 HUDSON STREET NEW YORK

Wimco Announces



The Wimco Variable Condenser

After months of experimentation to produce a really good Variable Condenser, we take pleasure in introducing to the trade The WIMCO Variable Condenser, which will be furnished in 43, 23, and 3 plate type. Tests conducted by the Washington Radio Laboratories show that The WIMCO Variable Condenser of the 43 plate type has a resistance, at maximum capacity, of but .018 ohms, and the capacity at zero on the scale is but 15 micro-microfarads. These values, we believe, are lower than in any other condenser manufactured for general amateur use.

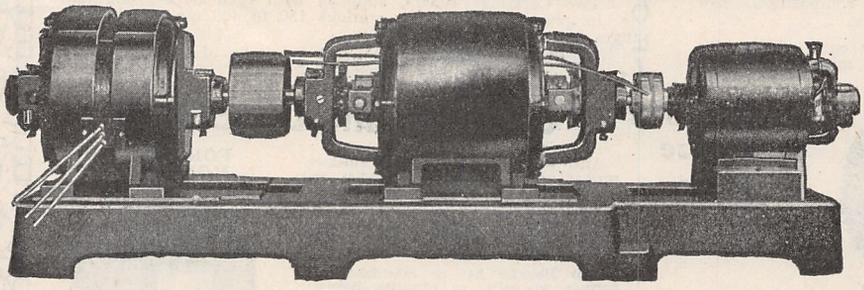
The WIMCO Variable Condenser is now in production and your orders will have our best attention.

We have a very attractive proposition for the Jobber, and solicit your inquiries. Write for complete price list and discount sheet.

THE WIRELESS MANUFACTURING CO., MANUFACTURERS DISTRIBUTORS **Canton, O.**

TRADE **ESCO** MARK

QUALITY ALWAYS HAS BEEN AND ALWAYS WILL BE, THE WORLD'S SAFEST INVESTMENT



ESCO

HIGH VOLTAGE MOTOR-GENERATORS STAND PRE-EMINENT

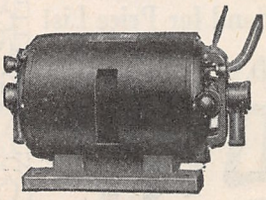
Used by Leading Educational Institutions, U. S. Army and Navy Academies, Research Laboratories, Newspapers, Dept. Stores and Broadcasting Stations

BULLETIN 237 LISTS OVER 200 COMBINATIONS

SPECIAL APPARATUS DEVELOPED FOR SPECIAL REQUIREMENTS

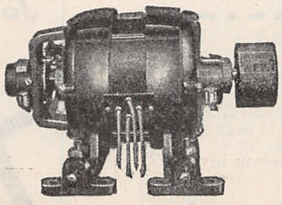
MOTORS—DYNAMOTORS—GENERATORS—MOTOR-GENERATORS

ELECTRIC SPECIALTY CO.



211 SOUTH STREET
STAMFORD
Conn., U. S. A.

SOLD BY
PRINCIPAL DEALERS
EVERYWHERE



New Radio Legislation is Needed

(*Continued from page* 1487)

public broadcasting waves are available, 360 and 400 meters, while the Government wave is 485, confining a very large amount of matter broadcasted by many stations to only three wave-lengths, and necessitating time schedules and silent periods. The assignment of waves under these recommendations, as well as other technical problems, would devolve upon the advisory committee. It is very likely that Secretary Hoover would secure the aid of the present Interdepartmental Radio Committee, or at least six of these technical experts as the Governmental representatives on his new committee.

Another feature planned if new legislation is secured is to make the wave band between 600 and 1,600 meters, now assigned for Governmental use, available to commercial and public stations. Details such as these, however, it is hoped will be left to the discretion of the Secretary. The art of radio is developing so rapidly as to demand constant changes and the permanent or specific designation of every wave or band of waves by law would be a hindrance.

SITUATION WORSE TODAY THAN ON JUNE 30

Interference is actually far worse today than it was five months ago, when Mr. Hoover's report closed at the end of the fiscal year. Instead of there being 382 broadcasting stations on 360 and 400 meters, there were actually 565 such stations in operation on December 1, or 179 more than existed on June 30. During the fiscal year seven commercial trans-Atlantic stations were placed in operation, providing for better communication with Great Britain, France, Italy, Japan, Norway, Poland and Germany. Another commercial station opened for business with Central America, and plans for circuits to South America and China were also under way. In the fiscal year ending June 30, 1922, commercial land stations, excluding broadcasters, increased from 161 to 345.

THE VALUE OF THE AMATEUR TO THE COUNTRY

Amateur station licenses increased from 10,809 to 15,504 between June 30, 1921, and June 30, 1922. In the past five months, however, 1,304 more stations have been licensed, bringing the total amateur sending stations to 16,888 on December 1. The increase in amateur interest by 5,999 is gratifying to the officials of the Government, for, they say, these young men constitute a reserve of trained operators, some of whom have already contributed to radio art. During the war many amateurs were found to be superior to the average commercial operator in resourcefulness and technical knowledge.

AN INTERNATIONAL CONFERENCE NEEDED

The necessity of an international conference on radio communication for the adjustment of international radio wave-lengths, especially those used between ship and store stations, is pointed out by Secretary Hoover in his report, attention being called to the fact that the last conference was in 1912 when the United States had but one trans-oceanic station in operation. This matter, however, has the attention of the State Department, which is now organizing the personnel of a representative Governmental committee to draw up agenda for the next international convention on electrical communication to be held at Paris next spring.

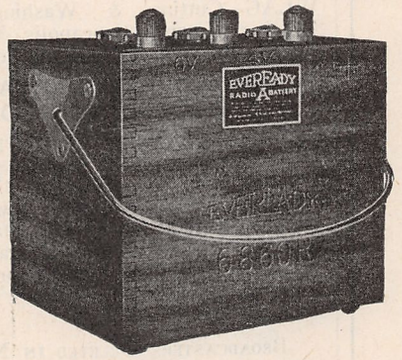
In summing up Mr. Hoover says:

"To close an efficient administration of the radio service is imperative if we are to maintain its efficiency as a life-saving

FOR BETTER RESULTS USE

EVEREADY

"A" and "B" BATTERIES WITH YOUR RADIO SET



EVEREADY "A" BATTERIES

No. 6810 - 50 Amp. Hrs. - $15.00
No. 6860 - 90 Amp. Hrs. - 18.00
No. 6880 - 110 Amp. Hrs. - 20.00

Hardwood Box, Mahogany Finish—Convenient Handle, Nickel Plated—Rubber Feet, Protect the Table

Cannot Be Accidentally Short-Circuited

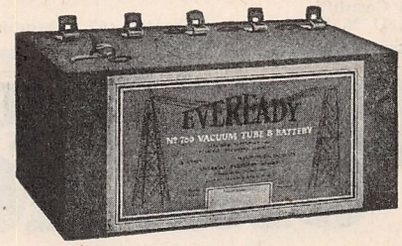
Unique arrangement of taps permits current to be drawn at 2, 4 or 6 volts.

EVEREADY "B" BATTERIES

Guaranteed to Be Absolutely Noiseless

No. 766 is the most popular size, and its use is recommended by most radio engineers and by experienced operators. The larger size of its 15 cells result in a much longer life, which far outbalances its increased cost over our No. 763. We strongly recommend the use of this No. 766 where ultimate economy is the important consideration. It is equipped with Fahnestock Spring Clip Binding Posts, giving variable voltages from 16½ to 22½ in 1½ volt steps. Dimensions: length 6⅝"; width 4"; height 3"; weight 3 lbs. 7 oz.

Price, $3.00



No. 763

Contains 15 cells of small size and enclosed in waterproof cardboard box. It is equipped with five brass strip positive taps ranging from 16½ to 22½ volts in 1½ volt steps, which covers the requirements of all present day soft detector tubes. Because of its limited capacity, due to its small cells, this battery is recommended for use only where light weight and small space are essential. Dimensions: length 3⅜"; width 2"; height 2½"; weight 13 oz.

Price $1.75

No. 767

Contains 30 cells of the same size as in No. 766. This battery was designed especially for use in connection with vacuum tube receiving sets em ploying a detector and one or more stages of amplification. In reality it is two No. 766's in one box. It therefore has the same desirable characteristics of economy and long life as the No. 766, and is recommended for use wherever 45 volts is required. It is provided with five positive taps ranging from 16½ to 22½ volts for detector tube control, and a 45 volt tap for the amplifier tubes. All terminals are of the Fahnestock Spring Clip Binding Post type. Dimensions: length 8"; width 6⅝"; height 3"; weight 9 lbs.

Price $5.50

No. 746

Contains 72 cells of the same size as in No. 766, and gives a maximum voltage of 108. It is equipped with Fahnestock Spring Clip Binding Posts giving following voltages: 16½, 18, 19½, 21, 22½, 45, 108. This type of battery is frequently used in connection with loud speaking devices requiring high amplification. With the above arrangements of taps, it is possible to use the same battery to operate not only the loud speaker, but the radio receiving set as well. These taps also make this an ideal battery for those who wish to experiment with a Super-Regenerative Circuit. The battery is assembled in a wooden box of neat appearance and sturdy construction. Dimensions: length 17"; width 9"; height 3½"; weight 20 lbs.

Price $15.00

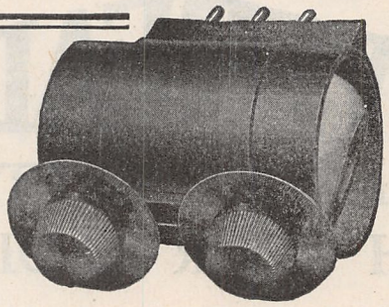
Columbia Ignitor Six-Inch Dry Cells equipped with Fahnestock Connectors

Columbia Dry Cells are suitable for the filament or "A" circuit of Westinghouse WD-11 Vacuum Tubes, which require one six-inch dry cell per tube

NATIONAL CARBON COMPANY, Inc.
Long Island City, N. Y.

Atlanta , **Chicago** , **Cleveland** , **Kansas City**

Compare TUNIT with Your Honey-Comb Coils for Short-Wave Work



FOR radio reception on 160-600 metres the Tunit is unexcelled. Its shielded dials, perfectly balanced, make the closest kind of tuning possible, without those objectionable capacity effects common to Honey-comb coils.

One man in Little Rock, Arkansas, hears W.J.Z. regularly every evening using a Tunit. Another in Bloomfield, N. J., tunes in the broadcasting stations at Chicago, Detroit, St. Louis, Atlanta and even Davenport, Iowa, with his Tunit. A third in Brooklyn, N. Y., copies amateur stations in every District but the sixth with one tube and a Tunit.

Most dealers sell Tunit. If yours cannot supply you, order from our nearest office, enclosing money order for $15.

SHIP OWNERS RADIO SERVICE INC.

SORSINC

80 Washington Street, New York

Wholesale Distributors

Boston, 46 Cornhill
Baltimore, 11 N. Eutaw St.
Seattle, 67 Columbia St.
San Francisco, 591 Mission St.
New Orleans, 740 Union St.

MEMORIZE CODE IN ONE HOUR

TRADE MARK BKUMA YRLSBUG REG. AP. FOR

ATTENTIVE BEGINNERS WHO USE

Dodge Two Dollar Radio Short Cut

DO MASTER CODE
IN MINUTES INSTEAD OF WEEKS

DO QUALIFY FOR EXAM
IN HOURS INSTEAD OF MONTHS

DO SUCCEED
AFTER TOTAL FAILURE WITH OTHER METHODS

9 CCW Reports memorized Code in TWENTY MINUTES.
2 BXY Qualified by 3 hours' practice—15-minute periods.
9 CPK Reports failed with every other method.

USUALLY PAYS TO INVESTIGATE B4 U BI.

For One Dime will mail Code Memorizing Records of Beginners in 12 Radio Districts who QUICKLY made themselves Licensed Operators.

For *Every Dime* of Cost Our Method *Saves Dollars.*

Please Note Price is Now TWO DOLLARS

C. K. DODGE, Dept. N, MAMARONECK, N. Y.

agency on shipboard, a means of commercial communication, and of instruction and entertainment for our people. To perform this work we must have an experienced and expert personnel. To secure and retain such men the service must be provided with adequate funds to meet the increasing demands of commercial enterprises for qualified men."

Radio Digest

(*Continued from page* 1482)

CLASS B STATIONS

Three Limited Commercial Class B Stations on 400 *Meters Were Transferred from A List During Week*

WHAS—Courier Journal and Louisville Times, Louisville, Ky.
WLAG—Cutting & Washington Radio Corp., Minneapolis, Minn.
KGW—Portland Oregonian, Portland, Ore.

BROADCASTING STATIONS GAINED AND LOST

During November the Department of Commerce licensed 46 broadcasting stations and cancelled 29. Three of those deleted were transferred to other ownership and have been recorded as new stations. The gain for the month was 17 stations, which indicates that the looked-for saturation point in broadcasting stations has not yet been reached.

BROADCASTERS DELETED IN NOVEMBER

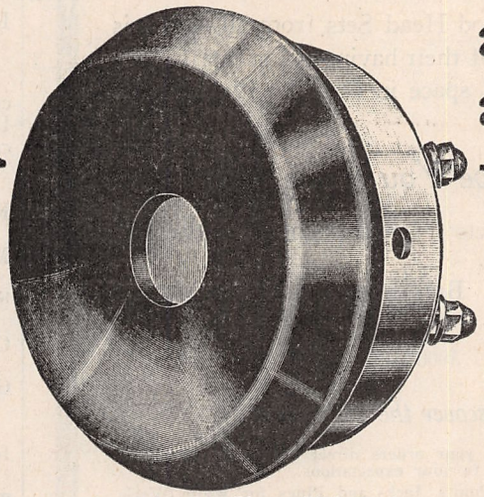
The stations whose licenses were cancelled in November follow:

WLAT—Bosch Co., Chas. G., Burlington, Iowa.
WBAE—Bradley Polytechnic Institute, Peoria, Ill.
WFAP—Brown's Business College, Peoria, Ill.
WIAN—Chronicle & News Pub. Co., Allentown, Pa.
KFAV—Cooke & Chapman, Venice, Cal.
KDZJ—Excelsior Radio Co., Eugene, Ore.
WKAJ—Fargo Plumbing & Heating Co., Fargo, N. D.
WKAT—Frankfort Morning Times, Frankfort, Ind.
WDAW—Georgia Railway & Power Co., Atlanta, Ga.
WGAF—Goller Radio Service, Tulsa, Okla.
KDYN—Great Western Radio Corp., Redwood, Cal.
WBAQ—Harmon, Myron L., South Bend, Ind.
KDYU—Herald Publishing Co., Klanath Falls, Ore.
WFAL—Houston Chronicle Pub. Co., Houston, Tex.
WSV—Hunter, Dr. L. M. & Carrington, G. L., Little Rock, Ark.
WHAL—Jeffrey & Derby, Lansing, Mich. (Now Lansing Capitol News).
WFAX—Kent, Arthur L., Binghamton, N. Y.
KHJ—Kierulff, G. R. & Co., Los Angeles, Cal. (Now Los Angeles Times).
WMAU—Louisiana State Fair Ass'n., Shreveport, La.
WIAG—Matthews Elect. Supply Co., Birmingham, Ala.
KFDB—McKee, John D., San Francisco, Cal. (Now Mercantile Trust Co., "B").
KDZD—Mitchell, W. R., Los Angeles, Cal.
KFAB—Pacific Radiofone Co., Inc., Portland, Ore.
WTK—Paris Radio Electric Co., Paris, Texas.
KYG—Radio Service Bureau, Inc., Portland, Ore.

Clearer than A Bell

THE "RICO" LOUD-SPEAKER PHONE

a remarkable phone



Loud-Speaker Phone With Cord

a remarkable price **$4.50**

Here is the **loud-speaker phone** for which you have been waiting! For the first time you are now able to buy a single 2,000-ohm **loud-speaker phone** that has been planned by radio **and acoustic** engineers for one purpose, and one purpose only—namely, to reproduce sounds clear and loud through a horn.

Used in any standard horn, it will amplify the weakest of sounds so that the whole family can hear your radio all over the house. Furnished complete with a five-foot (5 ft.) cord.

The RICO LOUD-SPEAKER PHONE will prove a revelation to you, if you have used regulation head receivers for loud-talkers.

We are so convinced that you will be enthusiastic about this phone that we make this

SPECIAL OFFER:

Try this LOUD-SPEAKER PHONE for five days, and simply consider the money you are sending in to us as a deposit. If, at the end of five days, you are not convinced that it is the best loud-talker phone you have ever seen or heard return it to us and your money will be promptly refunded.

SEND NO MONEY!

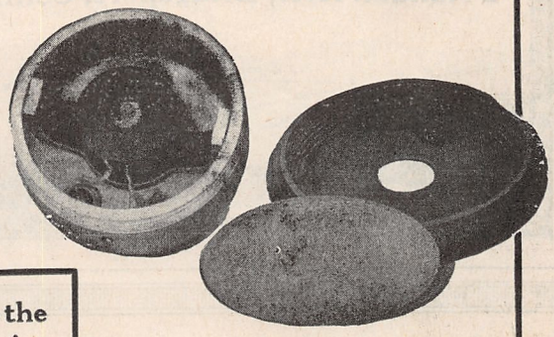
Just write us and tell us that you wish one or more (chose any type) of these phones, and we shall rush the order to you at once. Pay your postman the price of the phone and then test it out at our expense.

NOTE: The RICO Loud-Speaker No. 25 'Phone must be used in connection with a 1- or 2-stage amplifier or more.

Our No. 40-4000 double headset for long distance work is the finest pair of phones in the world at the lowest price, $9.50.

Note the new construction. The pull in the center of the diaphragm is where it should be, *in the mathematical center*. The result: Clear and loud tones, NO DISTORTION.

Rubber Covered Head Band



RICO Tri-pole Head Sets are the fastest selling phones in America

Rico No. 20, 2000 ohm Double Head Set with pure rubber covering. Now **$5.00**

Rico No. 30, 3000 ohm Double Head Set with pure rubber covering. Now **$5.50**

Mail your order at once, if the dealer can not supply you. Insist upon RICO Tri-pole. There is a very good reason why you should use RICO phones, and that is they are different—not merely Phones, but

Phones built for Radio or Telephone Work

PRICE LIST

Parcel Post—Paid Anywhere in North America

No. 25	Special Loud-Speaker Phone with cord	$4.50
No. 20	2000 ohms Double Head Set	5.00
No. 30	3000 ohms Double Head Set	5.50
No. 40	4000 ohms Double Head Set	9.50
No. 50	5000 ohms Double Head Set	12.50
No. 60	6000 ohms Double Head Set	15.00
No. 10	1000 ohms Single Head Set	3.50
No. 15	1500 ohms Single Head Set	3.25
No. 75	75 ohms Double Head Set	5.00
No. 5	5 ohms Double Head Set	5.00
No. 2	1000 ohms Receiver only	2.00
No. 3	1500 ohms Receiver only	2.25
No. 05	5 ohms Receiver only	2.00
No. 075	75 ohms Receiver only Telephone Work	1.00

Guaranteed in Every Particular

WHAT THEY SAY

Gentlemen:—

The RICO receiver received and I have given it about ten days' hard test and find it everything that you claim for it. **It sure is a wonderful instrument. It is the best receiver I ever have seen.**

It will go to the highest and down to the lowest note without a vibration. I have recommended it to several other parties and you may expect more orders from the sale of this one.

I am using it in a Lober Loud Speaker horn

O. J. GARN,
1232 Lincoln Ave., Toledo, O.

Gentlemen:—

I received your Loud Speaker Phone (No. 25) in excellent condition and can say **that all you say for your phones is true.** I am only using 1 stage of audio frequency and **we can hear the city stations all over the house on your phone.**

Thanking you for your prompt delivery, I remain,

FRANK C. HEYMER,
2325 W. Huntington St., Philadelphia, Pa.

Dealers and Jobbers

Write for our wonderful proposition. Cash in on the fastest growing phone business in the United States.

MANUFACTURED BY

RADIO INDUSTRIES CORPORATION

131 Duane Street, New York City

CABLE ADDRESS: RICOTRADE, N. Y.

Super Sensitivity

The feature that distinguishes Elwood Head Sets from all others is their supreme sensitivity, the result of their having the greatest number of ampere turns within a given space in accord with this well known electrical principle.

Elwood Head Sets Give You Everything

If it's in the air, your "Elwood" gets it; gets it good and strong; under the most difficult interference.

Light weight, strong and durable. Brass cases, heavily nickeled. Comfortable head bands.

Price: 2000 ohms—5.50. 3000 ohms—6.50.

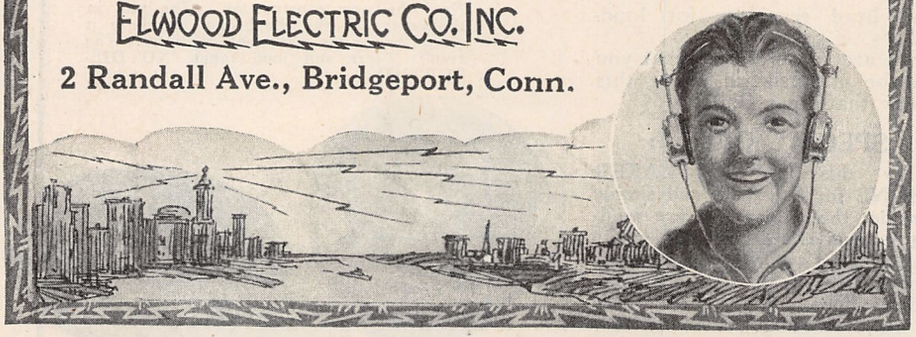
Test the Elwood and discover the difference

If your dealer cannot supply you, we will fill your orders direct on receipt of check. You are privileged to return headset if not up to your expectations.

We also manufacture Binding Posts, Contact Points, Jacks and Plugs for Radio Work.

ELWOOD ELECTRIC CO. INC.

2 Randall Ave., Bridgeport, Conn.



GREBE RADIO

GREBE distributors in EasternPennsylvania, Southern New Jersey, Delaware and Maryland.

The Famous Grebe Receivers are renowned for their sensitivity and expert workmanship.

We carry complete stocks of R.C.A. Products and others of merit.

PHILADELPHIA SCHOOL OF WIRELESS TELEGRAPHY PW

TRADE-MARK REGISTERED

Have your dealer order from us for immediate shipment.

Philadelphia Wireless Sales Corporation

Formerly Philadelphia School of Wireless Telegraphy

Wholesale Dept., 1533 Pine Street
Retail Dept., 1326 Arch St., PHILA.

WHAN—Southwestern Radio Co., Wichitau, Kans.
WDAA—Ward-Belmont School, Nashville, Tenn.
WHAT—Yale Democrat & Yale Telephone Co., Yale, Okla.
WEAZ—Redmond, Donald, Waterloo, Iowa.

NINE MORE BROADCASTERS

The supplement list of Limited Commercial or Broadcasting Stations issued by the Department of Commerce November 29th, carries 29 stations on 360 meters:

KFAV—Abbot-Kinney Co., Venice, Cal.
WPAM—Awerbach & Guettel, Topeka, Kans.
WHAL—Lansing Capitol News, Lansing, Mich.
WLAT—Radio and Specialty Co., Burlington, Iowa.
KFFA—Shelton, Dr. R. C., San Diego, Cal.
WNAY—Shipowners Radio Service, Baltimore, Md.
WPAD—Wieboldt & Co., Chicago, Ill.
WOAK—Collins Hardware Co., Frankfort, Ky.
WPAC—Donaldson Radio Co., Okmulgee, Okla.
KFGH—Leland Stanford Jr. University, Stanford Univ., Cal.
WOAH—Palmetto Radio Corp., Charleston, S. C.
WTAC—Penn Traffic Co., Johnstown, Pa.
KFDC—Radio Supply Co., Spokane, Wash.
WRAA—Rice Institute, Houston, Texas.
WTAU—Ruegy Battery & Elect. Co., Tecumsah, Neb.
WOAN—Vaughan, James D., Lawrenceburg, Tenn.
WOAL—Woods, Wm. E., Webster Grove, Mo.
KFGG—Astoria Budget, Astoria, Ore.
WPAG—Central Radio Co., Inc., Independence, Mo.
KFEJ—Greason, Guy, Tacoma, Wash.
WSAJ—Grove City College, Grove City, Pa.
WCAP—Kalamazoo College, Kalamazoo, Mich.
KFCL—Los Angeles Union Stock Yards, Los Angeles, Cal.
WOAR—Lundskow, Henry P., Kenosha, Wis.
KFCQ—Motor Service Station, Casper, Wyo.
WOAZ—Penick Hughes Co., Stanford, Texas.
WOAQ—Portsmouth Radio Assn., Portsmouth, Va.
WCAW—Woodmen of the World, Omaha, Neb.
KFDF—Wyoming Radio Corp., Casper, Wyo.

THREE NEW CLASS B STATIONS (400 METERS)

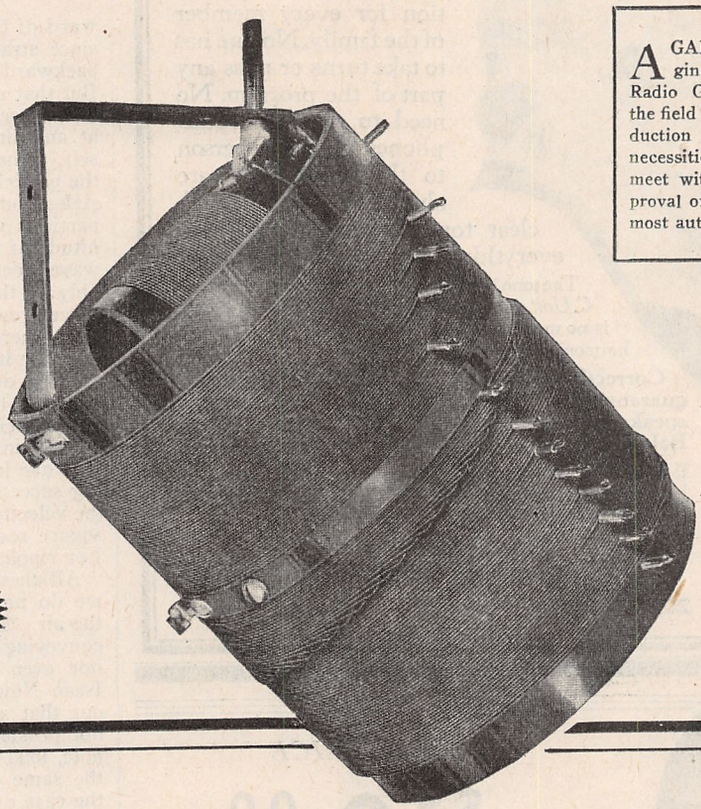
KFDB—Mercantile Trust Co. of Cal., San Francisco, Cal.
WIP—Gimbel Bros., Philadelphia, Pa.
KHJ—Times Mirror Co., Los Angeles, Cal.

ENGLAND LICENSES RECEIVING STATIONS

In England the fan is apparently badly handicapped, especially when the regulations are compared to the practice in this country. Amateur licenses for transmitting stations are not granted, but licenses for receiving sets are necessary. The latter are granted only to British subjects for bona fide experimental purposes at a charge of ten shillings for nine months. The postmaster general has charge of radio licensing and his restrictions and requirements would be considered unnecessarily severe in this country. No boys or girls under twenty-one are permitted to take out licenses to receive, receiving stations must pass inspection, tubes capable of transmitting

The Radio Guild Inc.

AGAIN the engineers of the Radio Guild lead the field in the production of radio necessities that meet with the approval of the foremost authorities.



KENNETH HARKNESS

whose career as an engineer-author in the radio field has been meteoric, has revised and rewritten the first edition of his exhaustive treatise on super-regeneration.

"THE CONSTRUCTION AND OPERATION OF SUPER-REGENERATIVE RECEIVERS."

This second edition of his work is now coming off the press. It has been highly commended by newspapers and has been approved and recommended by "Literary Digest," "N. Y. Evening Mail," "Washington Herald," "Atlanta Journal," "Newark Ledger" and others. "Radio News," "Pacific Radio," "Q. S. T." and other radio magazines have also approved the work of Mr. Harkness.

It has been acclaimed as the only authentic source of information on the subject. "A fine contribution to the advancement of radio," "Instructions that translate the complications and bring the application of the new circuit within the grasp of all."

The booklet contains full theoretical information, with explanatory diagrams.

30 WIRING DIAGRAMS
MECHANICAL DRAWINGS
and PHOTOGRAPHS
PRICE 50 CENTS

"MULTI-RANGE"

Bank Wound Coupler

Passed the strict requirements of the RADIO NEWS LABORATORIES and awarded their Certificate of Merit.

Pronounced by the "N. Y. Evening Mail" Laboratories as "the finest bank wound coupler produced" and awarded their Certificate of Excellence.

Scientifically designed by experts, the "MULTI-RANGE" Coupler permits the easy construction of an efficient short and medium wave receiver at low cost. Wavelength Range 150 to 3,400 meters.

SPECIFICATIONS

Bakelite Tubing; green double silk covered wire, wound by hand and moisture proofed; heavy nickel-plated metal parts; convenient solder taps, 180° coupling; Litz wire rotor leads.

List Price—$11.00

DEALERS—The Multi-Range Coupler is widely advertised. Write for special discounts.

The Radio Guild, Inc.

256 W. 34th Street — Experts in radio frequency amplification. — New York, N. Y.

Designers and manufacturers of the "Vox Humana," the R. G. 510 and the "Dashboard Special."

The Telmacophone in Every Home

The Telmacophone in *your* home provides entertainment and instruction for every member of the family. No one has to take turns or miss any part of the program. No need to change headphones from one person to the other. You are always assured a loud, clear tone. Everybody can hear everything, clearly and distinctly.

The tone is produced by *original Baldwin Type C. Unit* and reflected into the outer horn. There is no metallic effect. Finished in black and gold to harmonize with any surroundings.

Correctly designed—fairly priced—unreservedly guaranteed. The ORIGINAL $20.00 loud speaker and still the BEST. With original Baldwin Type C. Unit. Price complete $20

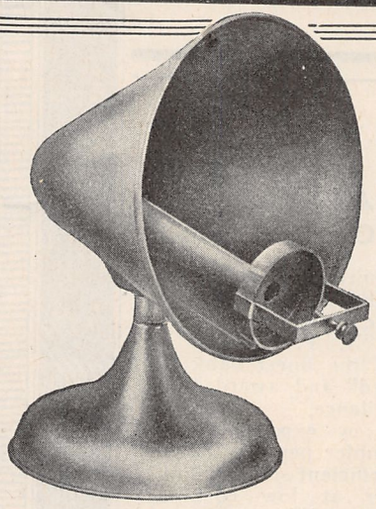
If your dealer hasn't the Telmacophone in stock, send us his name and order direct from this ad enclosing $20.00. Prompt shipment. *Write for new free catalog.*

TELMACO

Quality Radio Exclusively

JOBBERS! DEALERS! The demand for the Telmacophone is great. Write for new catalog and discounts on our complete line. We are also distributors for the better standard lines.

RADIO DIVISION
TELEPHONE MAINTENANCE CO.
20 S. Wells St. Dept. B Chicago, Illinois



LIST PRICE

$10.00

This Loud-R-Tone 3-in-1 horn is a Parlor and Auditorium entertainer. By sliding out center, horn can be used for transmitting music and lectures over the Telephone 2,000 to 3,000 miles.

The center horn is removable, so that it can be taken out and used for tuning; an extra pair of phones is unnecessary.

The entire horn is made of spun brass. It has no solder seams, thereby giving a beautiful, clear mellow tone.

Dealers 40% off. *Sample*—$6.00

Return Money

Will return money, if dissatisfied, any time within 15 days of shipment. Adjustable for every make of a Phone, receiver, large or small. Adjustable for tone. Center horn slides in and out for adjustment and tuning in.

Jobbers—Dealers—Get our discounts.

WILLIAMS SPECIALTY CO.
465 Dean St.
BROOKLYN, N. Y.

LOUD-R-TONE 3-IN-1

TRADE MARK
GALENA ALL SENSITIVE GALENA CRYSTAL

Galena Crystal, Mounted 35c
Galena Crystal, Unmounted 25c
IMMEDIATE DELIVERY
Manufacturers, Jobbers, Dealers, Write for quantity prices

GALENA CRYSTAL MFG. CO.
2894 Fulton Street Brooklyn, N. Y.

Our moulded variometer and other moulded products will mean satisfied customers and more sales to you Mr. Jobber & Dealer, why not write to us for full particulars?

The RIDgewood RADio Shop
1603 Myrtle Ave., Ridgewood, L. I.

Amateurs we rewind and repair fones; send them to us

cannot be used for receiving and special applications certified to by responsible citizens must be filed before licenses are issued. Certain exceptions are made in cases of well-known foreign scientists, but their apparatus will probably be limited in range of reception and restricted to those of British make.

On the Transmission of Waves

(*Continued from page* 1446)

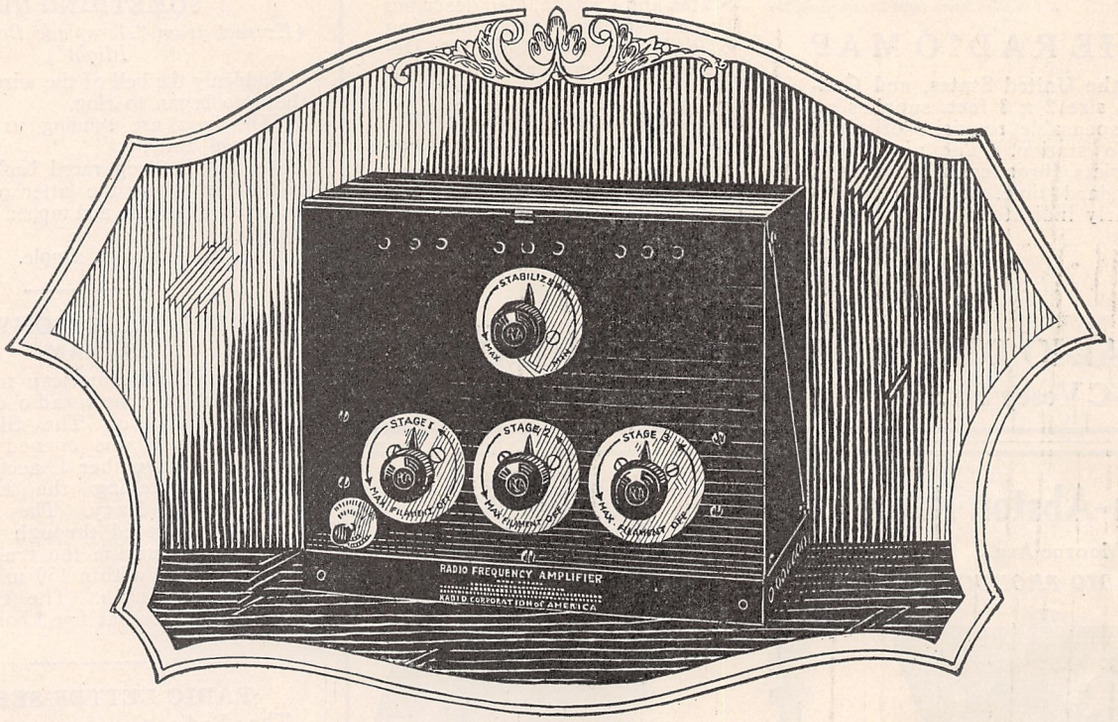
ward of the particles at the top of the crest, since straws and ripples on the surface go backward relative to the wave as it advances. But that only means that the water particles which are moving forward are not moving at anything like the speed of the wave itself. The wave is going much faster than the particles, and hence overtakes them, and slides under them. The speed of the water particles varies with the amplitude or magnitude of the disturbance. The speed of the wave does not depend on that at all, but only on the wave length, that is, on the distance from crest to crest; whether the wave is a mere inequality of the surface, or whether it rises twenty or thirty feet. The velocity of the wave—the speed with which the crest itself advances—depends not at all on the height or intensity of the wave; but it does, in the case of a water wave, depend on wave length, i.e., on the distance separating successive crests. In fact in deep water the velocity of wave-progress varies with the square root of wave length, for big waves. For ripples the law is different.

All these things are complications which we do not find in the Ether, nor even in the air. The speed of sound depends on the conveying material only, not on loudness, nor even on wave length or pitch. Sir Isaac Newton realized that, for he pointed out that a band heard at a distance could not possibly sound like music unless every note, loud or soft, high or low, had one and the same rate of travel. So it is also in the case of light and wireless waves. They all travel through the Ether at one identical pace, whether they be a hundred miles long, or the millionth of an inch short. Also whether they be bright like sunlight near the sun, or dim like a rushlight or a glow-worm. In this respect therefore Ether and Air waves differ from visible waves on the surface of the water. But all waves agree in this, that the potential and kinetic energies—that is, the displacements and the velocities,—are concurrent in phase, rising to a maximum and falling to a minimum together. This is a peculiar condition, destructive of equilibrium, and it can only be satisfied by the wave advancing through the medium at its own proper pace, a pace which in Wireless waves is determined by the mutual reaction of the electric and the magnetic components, in accordance with what is called Poynting's Theorem.

A receiver acts by obliterating some of the electric component, and thereby stops a position of the wave. This it does either directly, as by a linear aerial, or inductively, as by a loop aerial. The energy of such portion of the wave as effectively encounters the aerial is abstracted and utilised for the signal, some fraction of it degenerating into heat. The rest of the wave goes on.

So to sum up. The electric and magnetic components of a wireless or electromagnetic wave are at right angles to each other, and are equal in energy and coincident in phase, so that both reach a maximum, a minimum, or a zero, together. There is no lag of one behind the other, such as occurs naturally in all our emitting or receiving instruments. And the only way in which this curious unstable condition of things can be sustained, is for them both to advance forward with the velocity of light. And that is just what

Reach out for GREATER DISTANCE!



JUST as you can command a better view of surrounding country from a lofty tower, so can you select at will from the programs of many broadcasting stations with the new Radiola Model AA-1520, a three-stage, radio-frequency amplifier.

Radiola AA-1520 makes possible excellent reception with nothing more than an indoor loop antenna, a variable condenser for tuning, and the customary detector and two-stage amplifiers. It amplifies the feeble energy received from the distant station so that the addition of the usual detector and two-stage, audio-frequency amplification will allow the use of a loud speaker for local broadcasting stations. And of course, when head telephones are worn, one may listen to stations beyond the "loud speaking" range.

A really handsome receiver can be made up of model AA-1520 in combination with model AA-1400, a companion unit, and the new beautifully finished trays, placed top and bottom which contain the two models as a complete Radiola, attractive enough for the best appointed living room.

Your nearest RCA dealer will be glad to demonstrate.

Price of Radiola AA-1520 three-stage, radio-frequency amplifier—$80.00

No radio enthusiast should be without the book "Radio Enters the Home." Price 35 cents at your dealer or by mail.

Radio Corporation of America

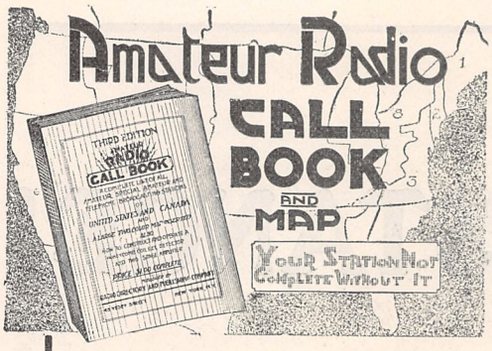
WORLD WIDE WIRELESS

RCA

This symbol of quality is your protection

Sales Office Suite 2065
233 Broadway
New York City

District Office
10 South La Salle St.
Chicago, Ill.



THE BOOK for RADIO FANS

The New Edition of the AMATEUR RADIO CALL BOOK is the most complete directory of amateur stations published to date—listing **Amateur, Special Amateur and Telephone Broadcasting Stations of the United States and Canada,** also describes the Construction and Operation of a Honeycomb Coil Set, Detector and Two Stage Amplifier.

THE RADIO MAP

Of the United States, and Canada, size 2 x 3 feet, supplies an indispensable requisite of every radio station. The nine radio districts, broadcasting stations, standard time, areas, etc., etc. clearly indicated.

Record Your DX Work

By pasting the map on heavy card board and using colored stick pins you can easily record your distant radio work.

At Your Dealer or Send Direct

PRICE book and map complete *(Do not send stamps)* **$1.00**

Dealers Write for Information

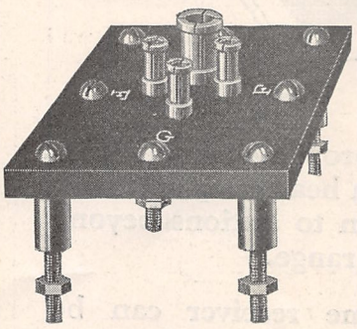
RADIO DIRECTORY & PUBLISHING CO.

45-C Vesey Street New York, N. Y.

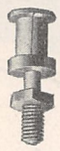
Ozburn-Abston Radio Co., Inc.

600-612 Monroe Ave., Memphis, Tenn.

RADIO PRODUCTS OF MERIT



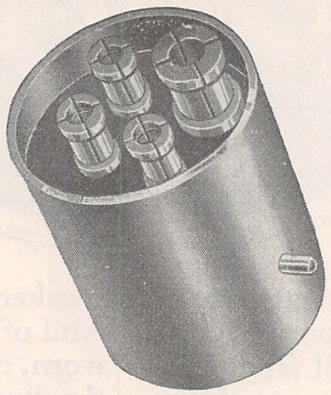
Positive contact socket for the one and one-half volt Aeriotron WD-11 tube. No loose or oxidized spring contacts, consequently no tube noises. Cat. No. B-2.
Price $1.25



MINIATURE JACKS for all uses

For standard tube prongs or for use with Miniature Plug. Cat. No. C-100. Price, 11c
For Phone Tips. Cat. No. C-101. Price 11c
For large prong of WD-11 tube or 50 watt tube. Cat. No. C-102.
Price 16c

Miniature Plug made of polished bakelite and nickel metal parts. Used to replace binding posts where quick, positive action is desired. Cat. No. C-1. Price, 25c



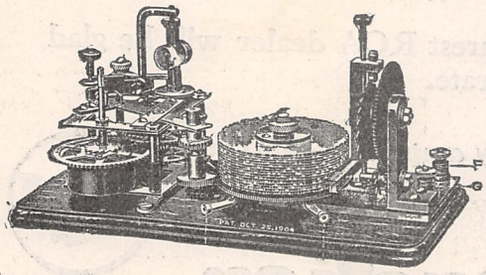
An Adapter for the Aeriotron WD-11 tube. Fits any standard socket. No wiring changes necessary, merely insert Adapter and substitute dry cell for 6 volt storage battery. Cat. No. 0-1. Price..... $1.40

LEARN THE CODE AT HOME

"Just Listen—The Omnigraph will do the teaching"

with the

OMNIGRAPH



THE **OMNIGRAPH** Automatic Transmitter will teach you both the Wireless and Morse Codes—**right in your own home**—quickly, easily and inexpensively. Connected with Buzzer, Buzzer and Phone or to Sounder, it will send you unlimited messages, at any speed, from 5 to 50 words a minute.

THE **OMNIGRAPH** is not an experiment. For more than 15 years, it has been sold all over the world with a money back guarantee. The **OMNIGRAPH** is used by several Depts. of the U. S. Govt.—in fact, the Dept. of Commerce uses the **OMNIGRAPH** to test all applicants applying for a Radio license. The **OMNIGRAPH** has been successfully adopted by the leading Universities, Colleges and Radio Schools.

Send for FREE Catalog describing three models, $14 to $30. DO IT TODAY.

The Omnigraph Mfg. Co., 20 Hudson St., New York City

If you own a Radio Phone set and don't know the code—you are missing most of the fun

MONEY for YOU Add to your Salary—Make extra Pin Money. Start a lucrative business of your own. Spend an hour each day taking subscriptions for the "Radio News." We'll pay you well and you'll enjoy the work. Write for ful lparticulars. Circulation Dept. RADIO NEWS, 53 Park Place, N. Y. C.

they do. The oscillator is stationary, true, but then the two disturbances there are not in phase. One is a quarter period behind the other, as one would expect: then the energy mainly pulsates, first out, then in, and is not all lost by radiation. The only part lost by radiation is that which has got a quarter wave length away, where the one disturbance has caught up the other, and where the energy—that which is used in Wireless Telegraphy,—is flicked off into space.

SOMETHING NEW

(Extract from "Aeroplane Boys in Record Flight")

Suddenly the bell of the wireless on board the auto began to ring.

"The boys are sending us a message," exclaimed Billy.

He and Lathrop raced back up the hill to the car, where the latter placed the detector over his ears and tapped out his ready signal.

After all—radio is simple.

SWEDISH RADIO COMPASS CALL IS "SAM."

The good old American name S A M is the call of a new radio compass station at Hallo on The Skagerrak, in Sweden, which was opened for general service on November 1, according to information reaching the Hydrographic Office of the Navy. The new station, which is operated through Goteborg, S A B, will determine the true bearing of vessels calling within 150 miles on a 600 meter wave length. The charge for a bearing is placed at five kronor or about $1.34.

RADIO LETTER SERVICE

The Radio Corporation of America has announced a radio letter service to London and Germany at a rate slightly higher than postage. The rate is six cents per word and the messages, filed any day in the week up to Saturday with the designation for "radio letter", will be transmitted to London or Germany for delivery on the following Monday morning.

SAVING BY RADIO COMMUNICATION

The Signal Corps of the Army in Washington continues to save money through the transmission of official messages by radio instead of by land wires. In September a total of 239,826 words were handled, with a saving for the month of $2,668 over what the cost would have been at commercial rates.

RADIO ADDS TO THE MAIL

To THE NEW YORK HERALD: Your editorial article in regard to the Government's increased postal receipts touched upon a point I had been thinking about for some time. Aside from the fact that better times should account for a good postal business, I believe that radiophone broadcasting is no mean item in the account.

There are about 530 broadcasting stations in the United States, and others at Havana, Cuba, and San Juan, Porto Rico. About 30 are very powerful and they receive all the way from three to six thousand letters from radiophone listeners every day. At 5,000 letters each this would mean 150,000 letters for the 30. About 100 stations will receive say 1,000 letters daily; 50 stations 500 each, and 350 stations say 200 letters daily. This makes a total of 345,000.

Now at a fair estimate probably 75 per

Don't Blame it on Static!

The Real Explanation of Much of the Trouble You Have with Your Radio Set

ONE of the things which the radio world is rapidly learning is that the term "static" has been very loosely used to cover a multitude of radio sins for which static is really in no way responsible.

It is discovering that many of the frying, crackling noises and much of the so-called interference laid at static's door are due to nothing more or less than *the use of batteries of the wrong kind or that leak an excessive amount of electricity.*

Any one of these battery faults can undo the most careful work in construction of set and aerials, and usually not only one but two or three of them are present in the same place.

Radio operators should remember particularly that "B" Batteries are in series with the phones or amplifying horn and that any noises set up within the "B" batteries themselves will come in strong. You can demonstrate this to yourself by scratching your "B" batteries with your finger-nail. The noise you get through your phones will surprise you.

A growing understanding of these facts is leading to much greater care in the selection of batteries and to the use of high-grade storage batteries for both A and B work, since such storage batteries have just the characteristics needed for both efficiency and economy in radio service.

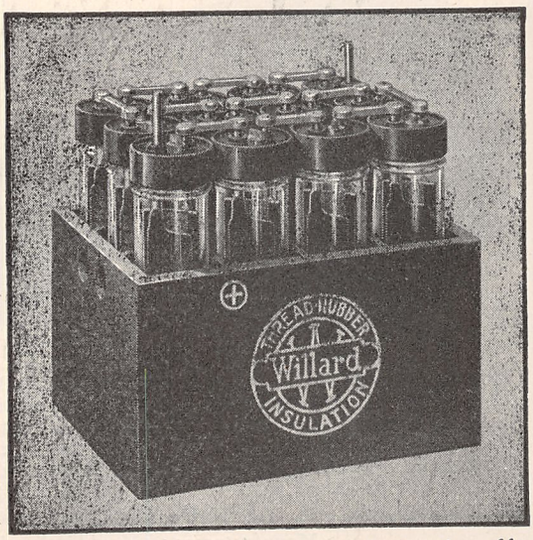
An interesting development in this connection is the new type of "B" battery and an all-rubber "A" battery put on the market by the Willard company. In these batteries, electrical leakage, which is present to such a great extent in the ordinary battery and which accounts for so much noise, is to a great extent ingeniously overcome.

The "B" battery cells are cylindrical glass jars with hard-rubber, screwed-on covers. These are so spaced that the only contact between cells is through heavy, burned-on connectors. No sealing compound is used and the box is cut down so that the sides reach up only about half way to the tops of the jars.

These features and the use of threaded-rubber insulation, operators find, result in a battery which holds its voltage, is never sluggish and, with occasional recharging, lasts for years.

Inasmuch as this big improvement can be effected at an actual saving of money because of the long life of a really good storage battery, there is no question that this type of battery will rapidly be adopted for a great majority of sets. When this is done, the bugaboo of "static" will lose much of its terror.

Willard Storage Battery Co., Cleveland, Ohio

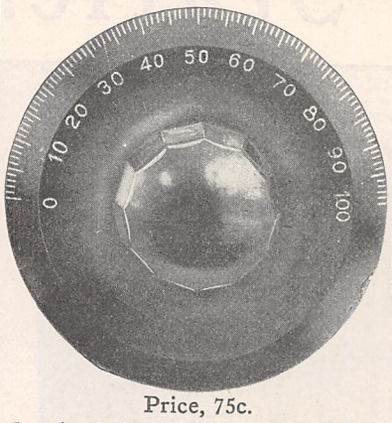


The Willard Radio "B" Battery is a 24-volt rechargeable battery. Glass jars — Threaded Rubber Insulation — screwed-on covers.

The Willard 6-volt, All-Rubber Radio "A" Battery has one-piece rubber case—Threaded Rubber Insulation—special Radio plates.

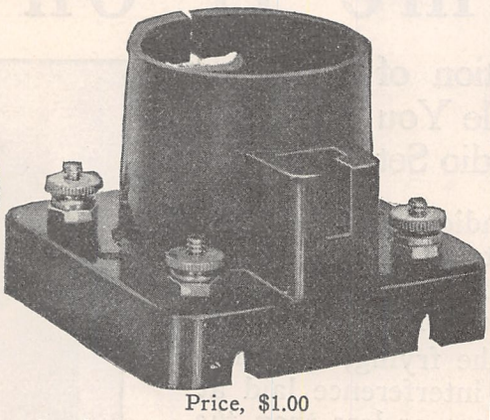
The new Willard lower priced Radio "A" Battery (Type FW) Willard-quality plates—selected wood separators—tested rubber jars, specially-designed terminals.

BELL MOULDED BAKELITE RADIO PARTS



Price, 75c.

Genuine Bakelite highly polished. Fine clear cut graduations and numerals.
Knurled knob fits fingers perfectly and allows fine adjustment.
No corners to catch dust.
Moulded stops—Runs true.
3½ in. Dial.



Price, $1.00

Genuine Bakelite. Heavily nickeled phosphor bronze springs designed to make double electrical contact.
Adapted for panel or base mounting.
Reinforced T slot allowing use of sending or receiving tubes without adjustment.

Attractive Discounts to the Trade

Manufacturers of Moulded Insulation since 1911

BELL MANUFACTURING CO., 14 Elkins St., BOSTON, MASS.

VUL-COT Fibre

is always free of foreign substances

VUL-COT Fibre is made by the orginal makers of Vulcanized Fibre. It has high di-electric strength (electric rupture 400 volts per mil.) and keeps di-electric losses as a negligible minimum.

These characteristics of VUL-COT Fibre are built into it when the fibre is made.

And in the making of VUL-COT Fibre we inspect, dust and sort all our own rags and also make our own paper. This insures the uniformity of VUL-COT Fibre.

VUL-COT Fibre comes in sheets, rods and tubes or machined to your specifications.

AMERICAN VULCANIZED FIBRE CO.
503 Equitable Building, Wilmington, Del.

SALES OFFICES

BOSTON PHILADELPHIA CLEVELAND CHICAGO
NEW YORK PITTSBURGH DETROIT ST LOUIS

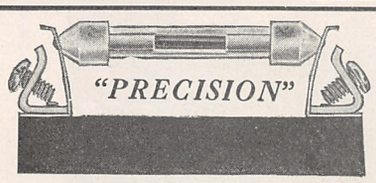
Complete Stock for Immediate Shipment at Chicago

Western Agents — *Western Electric Company* (INCORPORATED)
SAN FRANCISCO SEATTLE
PORTLAND LOS ANGELES
OAKLAND

Canadian Agents — *Northern Electric Company* (LIMITED)
MONTREAL TORONTO WINNIPEG
OTTAWA HALIFAX CALGARY
REGINA VANCOUVER

BY INVITATION MEMBER OF — NEW YORK U.S.A.

VUL-COT Fibre



HIGH RESISTANCES 60c.

Ranging from .25 to 5 megohms. Made by specialists in this line for use in all Radio Circuits. Individually calibrated. Accuracy guaranteed. Lower values on order.
12,000 ohm Resistance $1.00
Mountings ..... .50

Radiophone Equipment Co.
47 New Street, Newark, N. J.

SPAULDING Fibre PRODUCTS

Special Parts To Blueprint

Sheets, rods, tubes, everything in Fibre for the Radio Mfgr.

J. Spaulding & Sons Co., Inc.

NEW YORK ..... 484 Broome Street
BOSTON ..... 15 Elkins Street
PHILADELPHIA ..... 141 North 4th Street
CHICAGO ..... 659 W. Lake Street
TONAWANDA ..... New York

HAVE YOU SOMETHING TO SELL OR EXCHANGE?
A classified ad in Radio News will reach over 225,000 at a cost of only fifteen cents a word.

cent of these letters are acknowledged, which would mean 258,000 more, or in round numbers say 600,000 letters daily. Now add to this the thousands of pounds of radio material catalogs sent by mail and then on top of this the thousands of packages of radio material sent by parcel post and we can easily picture a good husky postal increase in a line that did not exist prior to 12 months ago.

FRANK H. JONES, E. E.
Tuinucu, Cuba, November 17.

As the above letter shows, there evidently is nothing that Radio cannot accomplish, even to the financial gain of Uncle Sam's Post Office.

Next we shall probably hear that it is beneficial also to the undertaking business, having already been of great help to the bootleggers.—EDITOR.

Sheet Celluloid

(*Continued from page* 1475)

can be obtained by this method. Two or three thicknesses cemented together make a more ornamental panel than bakelite, and anti-capacity shields of foil can be placed between sheets. I have constructed a loose coupler using two coils (primary and secondary), using identically the same winding shown on page 452 of the September issue of RADIO NEWS, "Different Type of Inductance Coil."

For the guide-pins I used celluloid knitting or crochet needles of a large size. These were cemented in a hardwood base. The secondary is of similar construction, but small enough to go inside the primary. No attempt was made to construct a vario-coupler, although this could have been done.

As there is not much interference here, I use it at full coupling. One of the guide pins of the primary coil is given a curve, so that a switch lever can cut turns of wire in and out of the circuit for tuning. The coils are panel mounted, the curved guide-pin fitting in a slot in the panel, with switch lever mounted on the panel in the usual way.

Contributed by JACK ROGERS,
Eldorado, Ark.

Secrecy In Radio Communication

(*Continued from page* 1445)

one transmission is a sound interval and the first interval of number two is a sound interval, the two will be joined together. It is obvious that under such conditions, the signals in a telephone receiver are a hopeless jumble.

Of course, the receiving apparatus which operates in connection with this multiple transmission is so arranged that the signals are separated and the signals from each transmission are typed on a separate machine.

In addition to secrecy, the use of the five unit code in this manner also effects a considerable transmission economy. At the same transmitting frequency, the five unit code will transmit eight words in the same length of time required to transmit five words by Morse code.

It is well known that when the speed of radio transmission is increased, the transmitted wave becomes quite broad, which, of course, is objectionable. With the Teletype

MAGNAVOX Radio
"A Public Institution"

THE real progress of radio is shown by the illustrated magazines and newspaper supplements—nobody follows the popular thought closer than the "art editor."

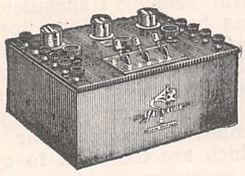
The preponderance of Magnavox equipment in these illustrations of novel and interesting radio uses, indicates how the Magnavox Radio, like the Morse Telegraph or the Bell Telephone, is becoming a "public institution."

R-2 Magnavox Radio with 18-inch horn
(as illustrated)

This instrument is intended for those who wish the utmost in amplifying power: for clubs, hotels, dance halls, large audiences, etc. It requires only .6 of an ampere for the field.
Price $85.00

R-3 Magnavox Radio with 14-inch horn

The ideal instrument for use in homes, offices, amateur stations, etc. Same in principle and construction as Type R-2. Price $45.00



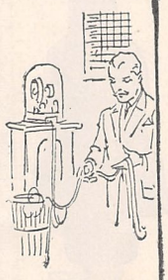
Model C Magnavox Power Amplifier

For use with the Magnavox Radio and insures getting the largest possible power input.
2-stage $ 80.00
3-stage 110.00

Magnavox products can be had of good dealers everywhere. Write our nearest office for copy of new illustrated folder.

No Wireless Receiving set complete without it.

Telling RADIO'S MESSAGES *to* ALL *the Family*



NOTHING unites the whole family like the possession of a wireless receiving set equipped with Magnavox Radio, the Reproducer Supreme.

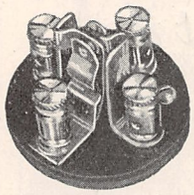
Radio's recent notable achievements—such as the broadcasting of Grand Opera—again prove conclusively that without the Magnavox, no receiving set is really complete.

The Magnavox Co., Oakland, California
New York: 370 Seventh Avenue

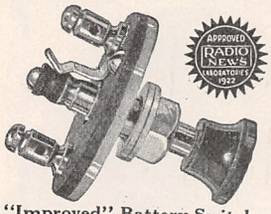
MAGNAVOX
Radio
The Reproducer Supreme

"IMPROVED" ANTI-CAPACITY JACKS

The First and Only Jack Designed Exclusively for Radio



"Improved" Double Circuit Jack. Price.....$1.00
Closed Circuit Jack.....85c
Open Circuit Jack.....70c
Single Circuit Filament Control.....$1.00



"Improved" Battery Switch Price.....$1.00
Double Circuit Filament Control.....1.25
Single Pole Double Throw Loading Coil Switch....1.25
Series Parallel Switch...1.50

AFTER putting up with adaptations of the old telephone jack for years, the radio industry has enthusiastically received the much-needed "Improved" Jacks.

The practical elimination of capacity by doing away with long parallel leads and the binding post terminals—no soldering necessary are features that especially appeal to the radio expert.

Many radio manufacturers, appreciating the value of the "Improved" Jacks, are now using them, adding to the appearance of their sets and saving money.

The "Improved" Battery Switch instantly connects or disconnects the "A" battery and protects your expensive set from tampering.

To the Trade

Our definite sales policy affords you protection. Wire, write or call for open territories.

RADIO IMPROVEMENT CO.

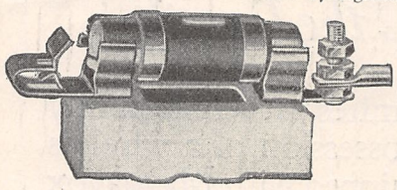
29 West 35th Street New York, N. Y.

They Last A Lifetime—

BRACH
VACUUM
RADIO PROTECTORS

With the development of radio and the desire for more complete and satisfactory equipment, comes the demand for absolute protection from the elements and from static interference.

Brach Vacuum Arresters dominate their field. They last a lifetime unless hit by a direct stroke of lightning.



Unscrupulous manufacturers of Air-Gap Arresters have made statements implying that Brach Arresters lose vacuum. These statements are intended to mislead and are not founded on truth.

Listed by the Underwriters' Laboratories

L. S. BRACH MFG. CO., Newark, New Jersey

Also Makers of Solderall—Best for Soldering Radio Connections

COAST REPRESENTATIVES—Pacific States Electric Co., San Francisco, Los Angeles, Oakland, Seattle, Portland, Spokane.

DEALERS:—

WE are Jobbers for

Grebe Receiving Sets
Murdock Products
Baldwin Phones
Federal, Fada and
Radio Shop Products

Write for Our Special Proposition A

The Radio Shop
OF NEWARK
76 Springfield Ave., Newark, N. J.

* * * * * * * *

"NOW I KNOW why the Jones's are so popular" said Mr. Brown to his wife as they were going home after a call at the Jones home.

"Regardless of when one visits them, they always have some new and delicious dainty to serve their guests or something new in games or music to entertain them."

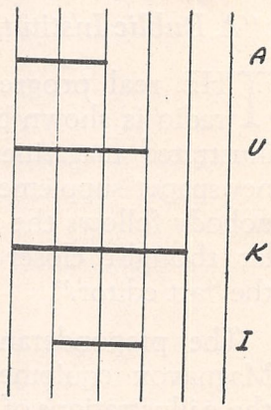
"Yes," replied Mrs. Brown, "and I try so hard to do likewise. I'll write immediately to the

AMSTERDAM SERVICE EXCHANGE
Amsterdam, Ohio

* * * * * * * *

WANTED—Back numbers of Radio News, Sept., Oct., Nov. and Dec., 1921, Jan. and Feb., 1922. Experimenter Publishing Co., Inc., 53 Park Place, New York City.

the same number of words per minute can be transmitted with the signaling frequency only 5/8 of the value necessary with Morse



COMPARISON OF LETTERS A, U, K & I FIVE UNIT CODE

transmission, or with the same signaling frequency, a proportionately greater output can be secured.

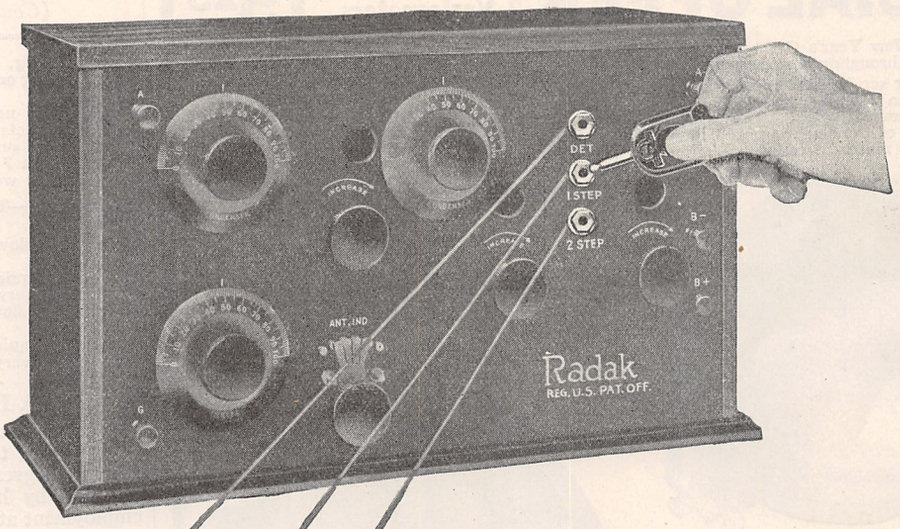
While the speed of the receiving typewriter is limited to about 45 words per minute, in the case of the tape typewriter, and 65 in the case of the page typewriter, with the multiple system, two or more receiving machines are operated from the same receiving apparatus and these machines are controlled from the same transmitting station on the same wave-length. This makes it possible to operate at the highest speed at which it is possible to secure good transmission. Each receiving machine types at a moderate speed which makes it possible to read the message as it is being received while the total output of the group of machines will be very high.

To further increase the secrecy of the transmission, the code combinations can be "scrambled." That is, the signaling intervals of the letter combination can be transposed. This is accomplished by very simple means and can be done quickly. In order that the receiving typewriter "unscramble" the combinations, it is only necessary to make a corresponding change at the receiving station. By this means, a multitude of variations can be produced and predetermined changes could be made several times per day if desired.

Successful Teletype transmission and reception has been carried on for distances as great as 800 miles. Of course, there is no more limitation of distance when using the Teletype than by any other method of radio telegraph operation except that a highly trained Morse operator may read signals which are too faint to operate the automatic apparatus.

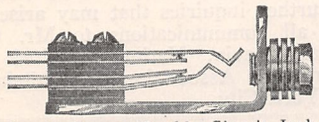
The radio transmitting apparatus is controlled by a keyboard which resembles that of an ordinary typewriter. Two methods of control are employed. In the first method when a keyboard key is struck, the radio signal corresponding to the letter is immediately transmitted. In the second method, the operation of the keyboard perforates the code combinations in a paper tape which is run through another instrument which in turn, controls the radio transmitter. The second method is employed where there is a large volume of business and higher efficiency is desired.

The use of the Teletype with its five unit code will help materially to remove some of the serious limitations of the present radio telegraph and put it on an equal footing with the land line telegraph and the cable as regards secrecy. This should make it available to agencies which now hesitate to use radio because it is not secret.

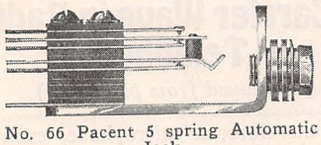


Pioneer Set Manufacturers "PACENTIZE"

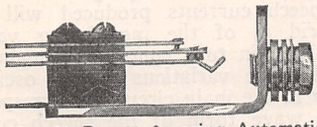
The Clapp-Eastham Company, America's oldest manufacturers of Radio Equipment exclusively, recognize the value of dependable radio essentials and use PACENT Jacks. This Model R. Z. RADAK Receiving set is equipped with PACENT Jacks.



No. 63 Pacent Double Circuit Jack



No. 66 Pacent 5 spring Automatic Jack



No. 65 Pacent 3 spring Automatic Jack

PACENT JACK SPECIFICATIONS

Coin Silver Contacts

Genuine German Silver Springs

Nickel Plated Brass Frames (not Iron)

Micarta Insulation (Not Fibre)

Extra Booster Springs

Husky Nipples

Rugged Construction Thruout

All Details Precisely Accurate

Provided with THREE WASHERS

Will Fit any Panel from 1/8 in. to 3/8 in.

There's a PACENT Plug and Jack device for every radio need.

Being pioneers, these manufacturers know the worth of equipment designed and made by pioneers. PACENT made the FIRST Radio Jack. Today, PACENT Jacks mark every step in advancement in radio essentials. PACENT Jacks recognize no superior in design, construction, choice of materials or dependability in service. The first choice of leading radio authorities and set manufacturers, PACENT Jacks, meet every requirement in radio work from the simplest to the most elaborate circuit.

DON'T IMPROVISE—"PACENTIZE"

Write for Descriptive Bulletins N2

PACENT ELECTRIC COMPANY

INCORPORATED

Manufacturers and Distributors of Radio and Electrical Essentials

Executive Offices: 22 Park Place, New York, N. Y.

BRANCH OFFICES

Philadelphia, Bourse Building
Chicago, 33 So. Clinton Street

Washington, D. C., Munsey Bldg.
San Francisco, Sheldon Bldg.

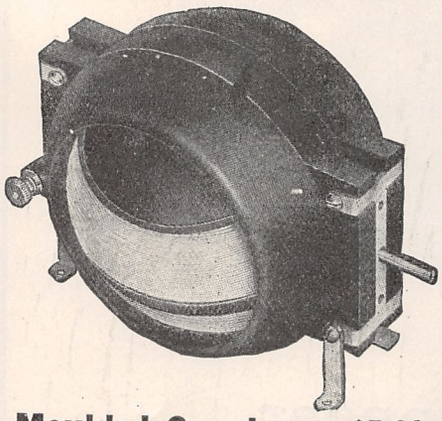
Members, Radio Section, Associated Mfrs. of Electrical Supplies

Canadian and British Licensees: Colonial Radio, Ltd., Hamilton, Can.

SPECIAL OFFER 1 Coupler 2 Variometers **$15.25**

Here is a real New Year's Greeting—"*Quality Products at rock bottom prices.*" This has been our policy throughout the past year, and will be continued by us during the coming year.

To introduce our service and apparatus to the dealers and radio fans who have not already purchased from us in the past, we are making a special combination offer of 2 moulded variometers and 1 moulded coupler at $15.25 postage prepaid. A description of these high grade instruments and illustrations of the same appear below. Obtain the substantial saving and our price list on other high grade materials today. *Write now!*

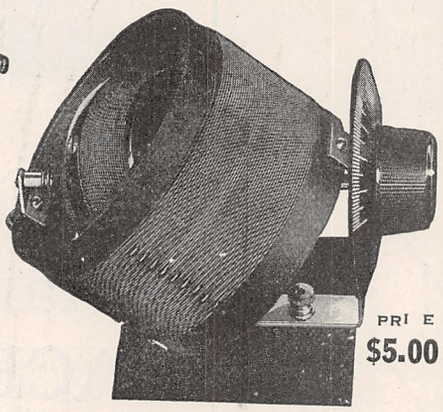


Moulded Variometers $5.50

VARIOMETER. The stators and rotor are moulded of hard rubber, and are highly polished. Green, double silk covered wire used. All parts nickel plated. Clearance between rotor and stator is .0005 with a + or − of .0002 either way Large dimensions permit the use of low resistance wire. No parafin shellac are used in wiring. Shaft 3/16" or 1/4". Wave length 150 to 650 meters.

Moulded Couplers $5.00

COUPLER. 180°. Rotor moulded of hard rubber, all windings of green double silk covered wire. Primary tube made of high di-electrical composition of 1/8" thick mounted at 45° angle, adapted for base or panel mounting. Shaft 3/16" or 1/4" nickel plated finish. Primary wound with 50 turns of wire tapped every fifth turn. Effective tuning range 150 to 650 meters.



PRICE **$5.00**

We pay transportation charges. If you are not satisfied in every way with our equipment, return it at once and we will refund the purchase price.

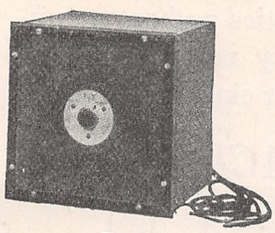
Radio Instrument and Panel Co. 26 N. DESPLAINES ST. CHICAGO. ILLINOIS

BETTER TONE FROM TIMMONS TALKER

A different and better

LOUD SPEAKER

THE TIMMONS TALKER



Price

$35.00

If your dealer cannot supply you, write us for information and booklet.

NOT merely a head phone attached to a horn, but a scientifically constructed instrument, with a simple, foolproof amplification which allows you to get the utmost from your set.

Its construction gives an unusual volume of beautifully mellow, rich tone which will make your set the talk of the neighborhood.

Built in a solid mahogany cabinet and needs no extra batteries.

J. S. TIMMONS

Germantown, Philadelphia, Pa.

WATCH FOR THE VARIABLE **SUPERAMPLIFIER**

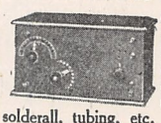
25 Radio Frequency Circuits Postpaid **75c**

simultaneous R. F. & Audio Ampl., TUNERS, etc.

SUPERAMPLIFIER CO.

514 Fullerton Ave., Chicago

MAKE YOUR OWN VACUUM TUBE SET



Concerts heard over 500 miles on this Receiver. Parts consist of: 6"x12" Formica Panel (holes bored), tuning coil (silk covered wire), variable condenser, grid lead condenser combined, vacuum tube socket, rheostat, switch lever, binding posts, solderall, tubing, etc. With simple directions. *Sent Postpaid for* ONLY **$9.90.** Mahogany finish Cabinet $2.45 extra.

ERNEST ELECTRIC CO.

4849 Easton Ave. St. Louis, Mo.

English Weather Report

(*Continued from page* 1488)

3 = Mod. fog. 5 cables.
4 = Thin fog or mist. 1 mile.
5 = Hazy. 2 miles.
6 = Horizon not visible from a height of 40 feet (or objects not visible at 4 miles).
7 = Horizon only just visible (or objects not visible at 7 miles).
8 = Horizon well defined.

TABLE 3.—TENDENCY OF BAROMETER

0 = Steady.
1 = Rising slowly.
2 = Rising.
3 = Rising quickly.
4 = Rising very rapidly.
5 = Falling slowly.
6 = Falling.
7 = Falling quickly.
8 = Falling very rapidly.

A HELPING HAND

Since the publication of a letter by Claude C. Levin in the November issue of RADIO NEWS, a great many inquiries have been received by him as to the possibilities of employment at sea, where to apply and other questions concerning marine service.

Mr. Levin has kindly offered to answer any further inquiries that may arise. Address all communications to Mr. Claude Cathcart Levin, National United Radio Telegraphers Association, 15 Whitehall St., New York City.

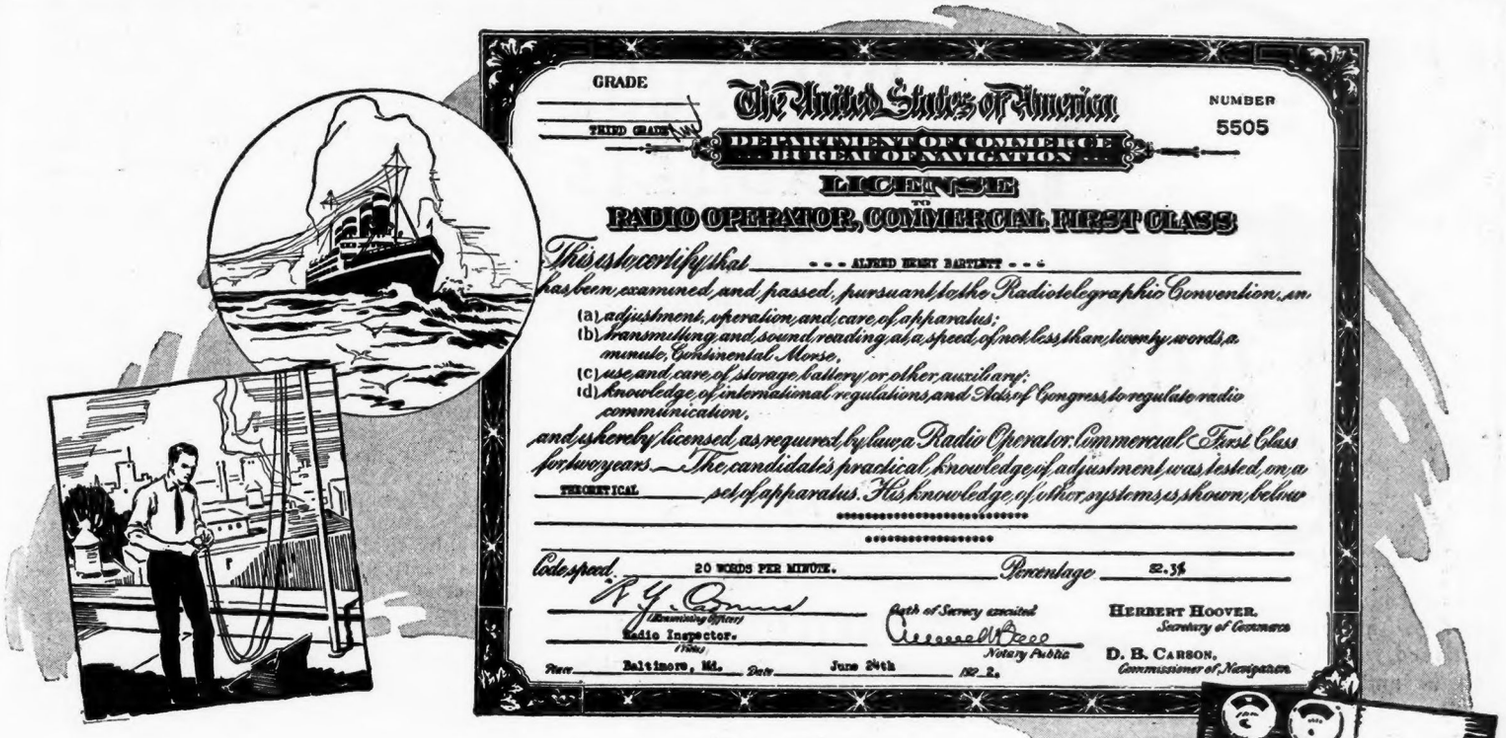
Method of Eliminating the Carrier Wave in Radio Telephony

(*Continued from page* 1469)

If, therefore, a microphone, such as E, is employed for the purpose of speech, the speech currents produced will affect the grid d_3 of the modulating valve D, which will in turn control the main valve A and cause variations in the oscillatory energy in the main circuit H corresponding to the wave form of the speech current; or telegraphic signalling may be effected, for example, by a Morse key j_1 in the potentiometer circuit, alternately throwing in and cutting out the negative potential on the grid of the modulating valve,

The operation of this system is based upon the fact that with a sufficient negative charge on the grid d_3, of the modulating valve D, the space between the anode d_2 and the filament d becomes non-conductive, and the grid a_1 of the main or power vlave A with its oscillatory circuit C, including the microphone transformer e, is insulated from the filament a of the power valve A, so that the negative charge on the grid a_1 of the power valve becomes so great as to reduce to a minimum the energy passing to the anode a_2 of the valve, oscillations therefore ceasing.

If, however, the negative charge on the grid d_3 of the modulating valve D is reduced, for example, periodically as the effect of speech currents, a greater or less amount of the negative charge is allowed to leak off from the grid a_1 of the power valve A through the filament d and the anode d_2 of the modulating valve back to the power valve filament a, thus setting up oscillations in the main power circuit H, having an amplitude determined by the decrease in the negative potential of the grid a_1 of the power valve. If no speech is impressed on the microphone E, the system is non-oscillating; or, if the system is used for telegraphy, it remains non-oscillating as long as the charge on the grid of the modulating valve is maintained at its normal level, but if, by a switch or key j_1, or any other means, the potentiometer battery J is disconnected or its potential altered so as to reduce the resistance through the modulating valve D, the system immediately starts oscillating.



Get This First Class Radio License

You Can Earn Big Money With It

THE best paid positions in Radio go to the men who hold the Government's Commercial License. The radio men on every ship, in every land commercial station, in every broadcasting station, must have one of these licenses. Every radio inspector must pass the first-class license examinations. Engineers, mechanics, installation and maintenance experts must all of them own a Government First-Class Commercial License. It is every radio man's ambition to get a license, not only because it is the highest mark of honor he can get but because it also opens to him all the wonderful opportunities in this great profession.

Emmett Welch of Peculiar, Mo., Radio Salesman, earns $300 per month and expenses paid. Merle M. Wetzel, while taking our course, was advanced from a lineman to Inspector in the Engineering Department of a Public Service Co. with a big increase in salary. George Staffa, as operator aboard ship, *averaged* $125 a month with all expenses paid. Read in the panel of the fine salaries paid in all the wonderful positions open to you as soon as you get the Government First-Class License.

Win Your First Class Government License This New, Easy Way

The National Radio Institute, America's first and largest Radio School, has devised a remarkable new method that makes it easy for you to win your license. No previous experience in electricity or radio is necessary. Lessons, so fascinating they read like an interesting romance, take you step by step through the whole wonderful science of radio. Spare time study at home prepares you in an amazingly short time to pass the government examinations, so you can get one of the fine jobs waiting in this great field.

Prominent radio experts give you personal instruction and advice. They grade your papers, answers your questions, give you every help you want so you can qualify quickly. The diploma we give you upon completion of the course, counts for 5 to 10 credits on all government license examinations.

The most important requirements for a commercial license is a knowledge of the Radio Code. One of the most extraordinary features of the Institute's comprehensive course is the four patented instruments, invented and owned by the National Radio Institute, giving you the practical training in radio operation, installation, maintenance and repair which you must have to become an expert.

Four Radio Instruments Free

Among these instruments is the wonderful Natrometer, said by experts to be the most perfect device ever invented to teach the Radio Code. With this amazing machine you quickly learn how to send and reecive code with all the speed, the accuracy and precision of a trained expert operator. No extra equipment is necessary. Simply connect a dry cell, adjust the head-phone, wind the motor, and for twenty minutes you can listen to a reproduction of the code-work of two of the most expert trans-Atlantic operators.

Interesting Book on Radio Free

Get into this fascinating profession now. The field is wide open; thousands of positions ar open. Find out at once your opportunities in radio. Send for the interesting free book, "How To Learn Radio at Home," which gives complete details of the plan by which the National Radio Institute qualifies you quickly in your spare time at home for Government Commercial license. If you are sincerely ambitious to win success and wealth in radio send the coupon or a postcard, now.

National Radio Institute, Dept. B-13 Washington, D. C.

Send me your free book, "How to Learn Radio at Home," with full particulars about the opportunities in radio, and how you will quickly train me in my spare time at home to win a Government First-Class Commercial License. Also tell me how your free Employment Service will help me to a position.

Name..... Age.....

Street.....

City.....State.....

MAKES MONEY MANUFACTURING SETS

The sudden demand fo rradiophones and receivers has created a fascinating, good-paying job for me. I have built one large receiver and two small ones, and am getting more. I am the first amateur to hold a license in this vicinity

E. E. MAHACEK,
Route No. 1, Crete, Nabr.

GETS $165 A MONTH

I am the only operator on board the "Lake Tulare" and receive a salary of $125 a month, with an additional $3 a day food-allowance while in port, totaling a cash pay of approximately $165 a month.

LEO. A. GOLDBLATT, Baltimore, Md.

IN CHARGE OF RADIO DEPARTMENT AND ADVERTISING MANAGER

I presume that you are somewhat interested in the amount of success the graduates of your school attain. The degree of success which your graduates arrive at is a criterion by which the school is judged by others. As you know I completed your prescribed course in Radio Telegraphy and Radio Telephony on July 21, 1920. At the present time I have complete charge of the Radio Department of True & Blanchard, Inc., of this place. This firm deals both retail and wholesale in Radio Equipment and Supplies. I also have charge of the advertising of The Vermont Radio Company of this city. REGINALD T. ALBEE,
Advertising Manager,
Vermont Radio Company, Newport, Vt.

EASY TO GET GOOD JOB

Only a short letter to let you know that I am still on board and waiting for the ship to sail. Tell your students for me that a man with a license has no trouble obtaining a good position. Believe me, a job like this is worth a good deal of studying.

L. M. WARING, JR.,
S.S. Lake Farney, Norfolk, Va.

$7.00 A DAY AS OPERATOR

Just sailed this morning for Norfolk, where we are to get a load of coal. I haven't much to do on board, and when in port not that much. I get $7.00 a day when in port, and can sleep on the ship. Not bad at all.

REVERE B. GURLEY,
On board S.S. "Lake Ysart."

Pick Out the Job You Want We Will Help You Get It

This is a brief list of the positions in the Radio field today, and the salaries paid:

Radio Mechanic, $1,500 to $2,000 a year.
Radio Inspector, $1,800 to $3,000 a year.
Radio Auditor, $1,200 to $1,800 a year.
Radio Salesman, $2,000 to $5,000 a year.
Radio Engineer, $3,500 a year and up.
Radio Executive, up to $10,000 a year.
Radio Aid, $6 to $10 a day.
Radio Draftsman, $7 to $10 a day.
First Class Ship Operator, $105 a month, all expenses paid.
Commercial Land Station Operator, $150 a month and up.
Broadcasting Station Operator, $125 to $250 a month.

NATIONAL RADIO INSTITUTE

Dept. B-13 1345 Pennsylvania Ave., N. W., Washington, D. C.

DREYFUSS HEAD SETS

The phones without distortion — ample volume. Designed especially for Radiophone reception.

A quality product — only the best materials used. Compare favorably with any phone made.

Prices

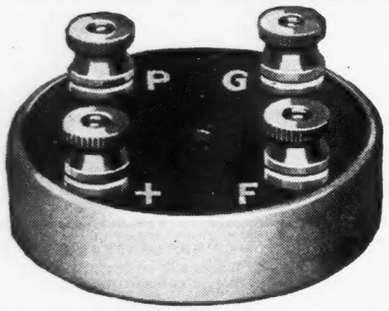
1000 ohm Single type - - - $4.75
2000 ohm Concert type - - - 8.00
3000 ohm Entertainment type - 12.00

OUR OFFER

Use our phones 10 days. If not satisfied, return to us and we will refund your money.

P. M. DREYFUSS CO., Inc.
150 Chambers Street New York, N. Y.

Branches:
179 Greenwich Street, New York, N. Y.
29 Cedar Street, Newark, N. J.



(Patent Pending)

Samples Mailed Free to Rated Jobbers

Radio Frequency Transformers $2

No radio set is complete without radio frequency amplification, and radio frequency amplification isn't perfect without Schindler's new improved transformers. Schindler's Transformers insure the highest type of amplification. They insure clearness, eliminate noise and static disturbance and bring the distant stations within your reach. Signals heretofore too weak for detection on outdoor antenna are made audible on small indoor loop aerials wherever Schindler's Transformers are applied. Price $2. Order direct if your dealer can't supply you.

(Patent Pending)

"Build-Up" Mica Condensers 35c

Schindler's "Build-Up" Mica Condensers insure high efficiency and full capacity. The "Build-Up" feature enables the operator to increase to any capacity up to .005 simply by adding extra plates of Mica and Copper Foil. 35c for capacity .0005.
An envelope containing 20 Mica and 20 Co per Plates, 25c. Order direct if your dealer hasn't Schindler's in stock.

Grid-Phone and Grid-Leak Condensers of definite capacity and resistance. Prices on application.

CHARLES SCHINDLER
Manufacturer of Radio Parts and Specialties
1401 W. Delaware
Toledo, Ohio

RADIO GOODS AT BARGAIN PRICES

SPECIAL FOR FEBRUARY

$5.00 Detector Tubes	$3.00
$6.50 Amplifier Tubes	3.50
$6.50—1½ V. Detector or Amplifier (fits standard socket)	5.25
8.50 Everett Phones (3000 ohms)	5.00
$1.75—22½ V. Cyclone variable B Batteries	1.00
75c Composition Dials, 3-inch	.40
$4.50 Thordarson Transformers	3.59
$3.75—23-plate variable Condensers	2.00
$4.75—43-plate variable endensers	2.69

Numerous other bargains in our FREE PRICE LIST sent upon request. Goods shipped POST-PAID promptly upon receipt of money or registered cash.

ALL MERCHANDISE GUARANTEED

Bergen Radio Supply Co.
Mail Order Department
606 Bergen Ave., New York City

SPRINGFIELD
16 Strand Braided
ANTENNA

Will increase your range with your present equipment giving 15% to 100% increase.

Most Important Invention
Buy of your dealer, or send us $2.50 for 100 feet.
Dealers and jobbers write for prices.

SPRINGFIELD WIRE & TINSEL CO.
387a Main St., Springfield Mass.

Get a Handy Binder for your RADIO NEWS. Holds and preserves six issues, each of which can be inserted or removed at will. Price 65c. Experimenter Pub. Co., Inc., Book Dept., 53 Park Place, New York.

anode d_2 of the modulating valve D and the oscillatory circuit C connected to the grid a_1 of the power valve A, provides a path for the passage of the high-frequency currents, the modulating valve D providing a variable high-resistance leak across the condenser d_1, which limits the value of the negative charge on the grid a_1 of the power valve A.

This system economizes the amount of high-potential energy normally consumed, as only the power valve A itself has impressed upon it the source B of high-pressure current, and an ordinary receiving valve of comparatively low vacuum can be used for modulating purposes. When used for telephony, the power employed in the main circuit H is a minimum when no speech is being transmitted, and the carrier wave present in many systems is entirely suppressed until brought into existence for the purpose of transmitting speech or telegraphic impulses. This is of special advantage for duplex or multiplex telegraphy or telephony, since the carrier wave is entirely absent at all "no speech" periods, and listening-in on the same wave length is therefore possible. A further advantage of the suppression of the carrier wave is the elimination or reduction of interference with other stations. Also, it may be pointed out that no unnecessarily high voltage is allowed to reach the transmitting key j_1, when the system is used for telegraphy.

Abstract from The Electrical Review

QST de MSU

(*Continued from page* 1465)

When this spark transmitter is used, transmission can be carried on over a long distance. The ship is never out of touch of land and the following incident which was related by chief operator Maudsley, would quickly relieve any doubt, as to the above statement. The first evening out from New York, the signals from MSU were plainly read by the operator aboard the steamer Finhead Castle, which had just left Cape Town. At that time both vessels were some 3,000 miles apart. This was no freak as could be plainly seen by the author when Maudsley related several other episodes, relative to distance covered.

The Aquitania carries a ½ kilowatt continuous wave transmitter, simple in design yet very efficient. It is capable of doing 1,000 miles or better in the daytime. The power supply for operating this outfit is derived from the same motor generator that is used in conjunction with the 5-K. W. set. There are two rectifying tubes and a power tube. The plug and jack idea is here also in evidence and by this arrangement a wide variety of wave-lengths can be used, as may be desired. It will go as high as 3,000 meters but communication is mostly always carried on with this set on either 1800 or 2100 meters. It is used most of the time while the ship is at sea, so as to cause as little interference as possible to others who might be trying to get off traffic. There is a tendency on the part of the operators to keep off spark as much as possible, except for intervals of three minutes as laid down by the British postmaster general. This time is set aside to listen for distress signals, etc.

Located on the right hand side of the main operating room, compactly installed in a neat cabinet, is located the ¼ kilowatt emergency transmitter and magnetic type receiving set. A bank of storage batteries numbering twenty-eight cells furnishes all necessary power for operating this outfit. The charging panel, used in conjunction with this set is located nearby.

An interesting feature aboard MSU is the radio equipped lifeboat. It is of unusual design, everything being compactly installed in a small tank, except the transmitting key

and the magnetic detector of the receiving unit. On one side is found the handle used in conjunction with the hand generator. This outfit is known as a "tank" set and is ideal for such use. Two bamboo masts are carried on the deck of this little vessel and can be easily and quickly raised. These support the twenty-five foot antenna which consists of four wires. A "ground" is had by simply screwing a large piece of copper to the keel and from which a connection is taken off. When raised in position the little aerial is well over thirty feet from the water line. Though this outfit has a guaranteed range of fifty miles, it is capable of doing much better.

The great antenna on the Aquitania is now a one wire affair, 385 feet long and about 175 feet from the surface of the water. A two wire aerial was previously employed but when this new "CW" set was put aboard, in place of the old one, it was found that there was too much inductance in the set itself to allow transmission on 2100 meters.

It is interesting to note that all three transmitting sets are worked off the same key. This is accomplished by employing a switch. It is also interesting to know that a big oil engine is carried on "B" deck. This would come in handy were something to happen to the main generator in the engine room. It would supply current for using the 5-K. W. transmitter and also light the emergency lights throughout the vessel.

But after all the life of a radio man aboard one of these great liners is not all pleasure. Every day the "Cunard Bulletin" must be published which means a great deal of extra work on the part of the three operators in copying the press reports. After this information is copied, it is rushed down to the printing room, there to be prepared for the press. As this data is sent at different times during the day, we can plainly see that all three operators will combine in getting it and all help to publish the paper. It contains some ten pages and is one of the most attractive and interesting papers published on any trans-atlantic liner. Besides this press matter intercepted by the operators, short stories and other interesting material is printed.

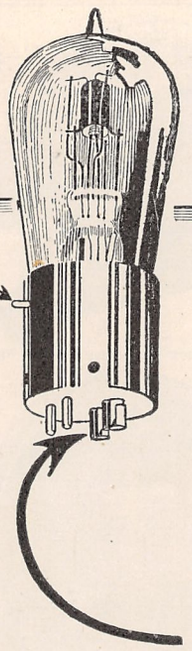
The operators are supposed to stand watches of four on and four off but they really work about twelve or sixteen hours a day. After they come off watch, accounts must be made up and also abstracts, reports, etc. During the busy season of the year, thousands of messages are handled and therefore we can readily see how busy the operators would be. It is not unusual to send messages containing five hundred or more words.

New DX Record Set by 6ZY at Honolulu, Hawaii

(*Continued from page* 1473)

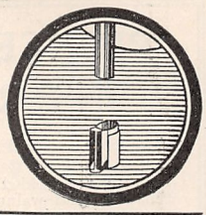
a real noise maker. His signals were injurious to my ear drums when listening to his sending. Several times he hit the key when I happened to be on his wave. The phones were doffed in absolutely nothing flat. His signals are actually QSA on straight detector, and can be read on a non-oscillatory condition. 6CP, 6ASJ, 6CU, and 6JD are also very QSA on one step of amplification. The writer has learned that the last four stations employ a synchronous rectifier and two 50 watters. The signals from these stations are much greater in audibility than from other stations located along the Pacific Coast, which speaks well of a "sink" rectifier.

The Beverage antenna used on the night of Oct. 28-29 was exactly 656 feet in length and connected to the ground through 540 ohms of inductive resistance. The condenser C1 has a capacity of approximately .0005 mfd. Very little capacity is required



We carry different capacity fuses for different amperage tubes.

When ordering, therefore, state exactly what tube fuses are for.



CAUTION:

Do not force fuse on filament terminals. If contact solder is rough, file or sandpaper down so that fuse slips on easily. Filament terminals are the two farthest from the locking projection on base of tube.

The Pig in the Alley

The whole point about "a pig in an alley" is that the alley is the strategic place in which to stop him. The reason why the

RADECO

SAFETY FUSE

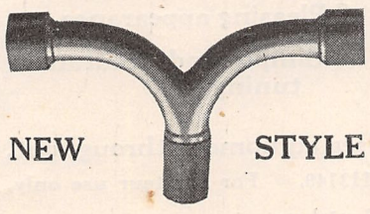
(pat. pending)

affords perfect protection against "blowing out" your Vacuum Tube is because it slips directly on the filament terminals where excess current simply *cannot* pass it.

The RADECO Safety Fuse fits any standard tube used in any standard socket. Absolutely does not affect the efficiency of your set and is guaged accurately to capacity. In standard packages of

4 for $1

Radeco W D 11 Fuse . . . 50c.



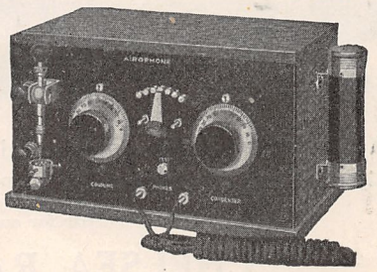
NEW STYLE

PHONE ADAPTERS

Connect your phones directly with loud sounder of your Victrola or Grafonola without trouble and without springing phone headpiece.

$2

Add Postage on 2 lbs.



Crystal Detecter Set

Biggest value made. Has Buzzer Test, Tapped Primary Vario Coupler, Var. Condenser, Cord Tipped Jacks, Bakelite Panel.

$20

WD11 ADAPTERS Jacks WD11 Tubes fit standard sockets - **$1.50**

NEW RADIO CALL BOOK *lists all U. S. and Canadian amateurs* - **50c.**

We carry a complete stock of standard goods. Order from any standard Catalog

RADIO EQUIPMENT CO.

630 Washington Street Boston, Mass.

New England's Oldest Exclusive Radio House

"PIONEER" RADIO INSTRUMENTS

Have been awarded Certificate of Merit No. 37 by the Radio News Laboratories.

Shells are molded from genuine Bakelite, in a rich circassian walnut finish—made in our own plant by special machinery.

Winding of both rotor and stator is with a double-thick silk-woven wire in a rich bright green shade.

Hardware is Brass, heavily nickeled.

Range—Perfectly balanced to 150-750 meter wave lengths.

Mounting for either Panel or table installation.

"PIONEER" VARIOCOUPLER

Only Coupler that is *inside-wound*, like a variometer! Close-coupling, effective insulation and special provision against "play" insures uniformly superior results.

"PIONEER" VARIOMETER

Like the "Pioneer" Variocoupler, a thing of beauty and a joy forever.

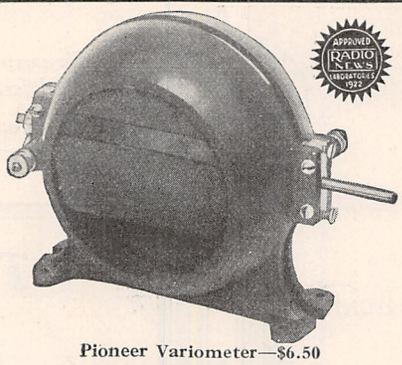
Internal resistance is reduced to a minimum by large size of wire used.

Connections are positive and the true relationship between rotor and stator fixed by our riding spring contact.

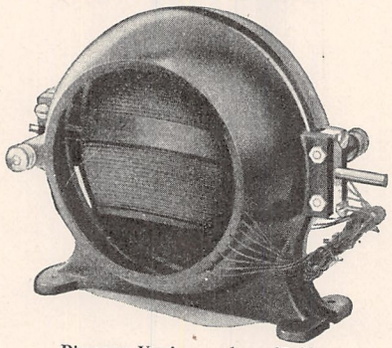
. . .

These instruments give "class" to any set in which they are used—and insure accurate, selective tuning and clearness of signals.

Send for circular and prices.



Pioneer Variometer—$6.50



Pioneer Variocoupler—$7.00

PIONEER RADIOPHONE CORPORATION - Galesburg, Illinois

CHELSEA REGENERATIVE RECEIVER

A real Broadcast Receiver

Range 150 to 800 meters

¶ Perfection in design

¶ Pleasing appearance

¶ Simple and accurate tuning

$40.00

A Chelsea product, embodying Chelsea equipment throughout.

Licensed under Armstrong U. S. Pat. No. 1113149. For amateur use only.

Write for our new No. 7 catalogue

CHELSEA RADIO COMPANY

179 Spruce Street **Chelsea, Mass.**

Dealers and Manufacturers

Attention

We Pay Spot Cash for Your Surplus Radio Stocks

Chicago Salvage Stock Store

509 S. State St., Chicago, Ill.

Unconditionally Guaranteed for 3 Years
(A Written Guarantee)

U. S. Storage Batteries

Supreme for Radio Telephone

6 Volts 20 amp. Guaranteed for 1 Year - $ 7.50
6 Volts 40 amp. $10.00 6 Volts 100 amp. 22.50
6 Volts 60 amp. 13.75 8 Volts 60 amp. 17.50
6 Volts 80 amp. 17.50
9 Cell B Storage Batteries 22½ Volt } Guaranteed 1 Year $7.50
20 Cell B Storage Batteries 50 Volt } Guaranteed 1 Year 13.75
40 Cell B Storage Batteries 100 Volt } Guaranteed 1 Year 26.00

If your dealer hasn't it, send money order or check direct.

Mail Orders Filled Upon Receipt of Price
PRICE LIST MAILED FREE
Dealers Write for Discounts

U. S. Storage Battery Co.

FAR ROCKAWAY, N. Y.

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year. Experimenter Publishing Co., 53 Park Place, N. Y. C.

for 200 meters. The addition of inductance and capacity will enable the amateur to receive special stations operating on 375 meters. 6ZE, 6ZF, and 6ZAC have been heard when operating on 375 meters. 6ZAC can be copied during the day time when the big Pearl Harbor arc is in operation. The mush emitted from the arc is flat in tone and is very QSA, but does not drown 6ZAC when properly tuned in on the Beverage. Very good results have been obtained in copying coast amateurs on the Beverage antenna when reception was absolutely impossible on an ordinary antenna. Considerable static reduction was also very noticeable. The Beverage type of antenna is therefore especially well recommended for amateurs where the interference is bad.

Considerable experimenting was carried on during the test in order to ascertain the greatest signal strength. The simple form of wave antenna as used by Godley at Androssan is not the most practical form, and does not therefore produce maximum signal strength from a distant station. Raising the antenna higher at the free end decreased the signal strength considerably. I found that the last 350 feet of the free end should be approximately 8 feet high. The increase in signal strength might be further due to the fact that the waves are somewhat retarded when passing over dry earth, that is, the lower part of the disturbance travels slower than the upper part which causes the field of the waves to be tilted in the direction of movement through the ether. The combined action of the two effects, i. e., velocity of current in the antenna and character of the waves near the ground cause a greater amount of energy to be absorbed by the flat portion of the antenna, resulting in an increased signal strength.

A Beverage antenna is very directional, and should, for this reason, be erected with the free end pointing towards the transmitting station by the great circle bearing route which is the shortest path for the ether waves to travel, due to the curvature of the earth. Since it is not possible for amateurs to have a great circle chart, I will give an example which will enable you to calculate a radio bearing which is a great circle bearing (GCB). Obtain your latitude and longitude, then determine the latitude and longitude of the transmitting station. By using the following method with a table of log, sines, tangents, and secants, you will be able to calculate a radio bearing for the distant station.

Amateur 6ZY located in Lat. 21 degrees 30 minutes North and Longitude 159 degrees and 20 minutes West, wishes to erect a Beverage antenna extending towards amateur 4KJ, Charlestown, N. C., located in Latitude 32 degrees 45 minutes and Longitude 79 degrees and 45 minutes. Find the GCB.

Solution.—Long 6ZY—long. 4KJ equals 158 20—
79 45 equals 78 35
78 degrees 35 mins. Cos. 9.29654 Cot. 9.30522
Lat. 4KJ 32 45 Cot. 10.19164

(a) 17 degrees 6 mins. Tang. .48818 Cosec. 10.53159
(a) plus Lat. 6ZY equals
17° 6′ plus 21° 30′ equals 38° 36′ Cosec. 9.89294

10 degrees 34 mins. GCB equals Cot. .72975
Ans. GCB equals 10 degrees and 34 minutes, or North 10° 34′ E.

My antenna would be located in a position having the free end pointing North 10 degrees and 34 minutes East in order to receive maximum energy from the passing waves transmitted by 4KJ.

It has come to the writer's attention that popular radio work has had a violent collision with old man static, the bugbear of radio reception, which exists so pronounced during the summer months. If a Beverage antenna is employed, I am of the opinion that that fearful distressing "ton-o-brick"

stuff will not lessen your radio work during the hot months. To the fellows who let radio DX work pass by during these months thereby causing their efficiency curves to flatten out, I prescribe a Beverage antenna as the most efficacious remedy.

8AKI

"The call letters 8AKI, issued to W. K. Aughenbaugh, 630 Franklin St., Johnstown, Pa., have been transferred to W. K. Aughenbaugh, 1432 12th Ave., Altoona, Pa. The transmitter in use at 8AKI at present is 5 watts I.C.W. 1100 volts A. C. on plate. 8AKI would be glad to have a card from anyone who has heard it."

Electrons, Electric Waves and Wireless Telephony

(*Continued from page* 1449)

and the liquid film tension on the other side will at once contract and pull the thread tight into the form of a curve, which then forms one boundary of the film. We see by this experiment that a liquid film is in a state of stretch or tension, and will always contract so as to make its surface area as small as is consistent with the boundary conditions. Hence it resists stretching and in virtue of this can have capillary or surface tension waves formed on it. There is one distinction between these two types of surface water wave which should be noted.

We have already explained that on deep water long gravitation waves travel faster than short ones. On the other hand, short capillary waves move faster than long ones. There is, therefore, a certain wavelength for surface waves on water, about two-thirds of an inch in length, at which surface waves travel at the slowest rate, viz., about 9 ins. a second.

This wave may be considered to lie on the boundary between true gravitation waves, which are longer, and true capillary waves, which are shorter than this critical length.

6. EXPERIMENTAL ILLUSTRATIONS OF WAVE PHENOMENA

It is possible with a certain type of apparatus to exhibit many interesting experiments with capillary waves on water which illustrate the properties of waves in general. As arranged by the author for lecture purposes this apparatus is as follows:—A circular shallow trough is constructed, having a plate-glass bottom and an exit tap. The trough may be about 8 ins. in diameter, and should be fitted with an overflow tube so as to keep a constant depth of about ½ or ¾ of an inch of water in it. This trough is placed on the stage of a vertical projection electric lantern so that light is sent through it and an image of any object on the surface of the water is focussed on the lantern screen. The trough is provided with a pair of fine supply tubes, by means of which drops of water coming from an elevated tank can be allowed to drop at regular intervals on the water surface in the shallow tanks. As each drop falls on the water it will start a ring-shaped capillary ripple, but this ripple flits outwards so rapidly the eye cannot follow it. We can, however, render it visible as follows. In front of the lantern objective we place a metal disc with 4 or 6 holes in it. The disc must be caused to rotate by a pulley and belt so that as it revolves it periodically eclipses and allows the light from the lantern to pass as in a cinema projector lantern. The result is that the image on the screen is seen intermittently. If, now, the rate at which the water drops fall on the water surface is so adjusted that the interval between two drops falling is equal to the interval between the passage of two holes

The Truth About RADION

Every man who buys a panel, dial or any other Radio part made of molded insulation, whether he be a manufacturer, a dealer or an amateur, is entitled to know these FACTS:

The four most important characteristics of insulating material for radio use are *low phase angle difference, low dielectric constant, high resistivity and non-absorbent qualities.*

RADION excels in all the above. Comparisons with Phenolic and Laminated Phenolic Insulations are as follows:

	RADION	Phenolic and Laminated Phenolic Materials
Phase Angle Difference	0.5 to 0.6	2.0 to 3.7
Dielectric Constant	3.9	5.8 to 7.4
Resistivity (Megohms—cm)	1.0×10^8	1.4×10^4 to 2.2×10^6
Absorption of Moisture:		
In Air	0.005% to 0.02%	0.28% to 0.49%
In Water	0.08% to 0.11%	1.42% to 7.81%

Figures given in the above table for phase angle difference, dielectric constant and resistivity were reported by the Bureau of Standards. Absorption of moisture in air and in water were determined in our own laboratory.

These results prove that RADION surpasses all other materials in electrical insulating properties, which are the most important to be considered in all electrical insulations, whether for radio or other purposes.

RADION is a special compound of hard rubber developed exclusively for radio use. It is non-porous, non-absorbent, warp resisting, absolutely permanent, may be easily molded or accurately machined to gauge, drilled, cut, threaded, sanded and polished without danger of chipping. RADION is supreme in the radio field.

Although RADION has these superior advantages *it costs less* than most insulating materials.

Genuine RADION is sold everywhere by dependable dealers.

Genuine RADION is stamped RADION on each panel or dial or printed on the container in which it is packed.

RADION panels are made in 15 stock sizes, each packed in an envelope to protect the beautiful finish.

If you fail to get it tell us. We will see that you are supplied.

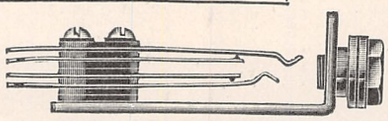
American Hard Rubber Co.
11 MERCER STREET NEW YORK

The "SATURN AUTOMATIC" RADIO PLUG $1.50

The More You Pull
The Better the Contact

No more taking apart to make connections. Just insert the terminals into the Saturn and a perfect contact is made. So constructed that pulling on the cords makes the connection more positive. Let your customers try this test themselves. It will convince them that the Saturn "Automatic" is far superior to any plug on the market. Instantaneous Disconnection just by touching this lever!
Every plug is sealed and fully guaranteed.

THE SATURN PERFECT JACK



This Jack is an improvement on all other Jacks on the market. The crowfoot offset allows easy soldering. The bracket is made of Brass, Nickel Plated; rounded corners. The Blades are of Spring German Silver. The Contact Points are Genuine Silver. The Nipples are shoulder type and are furnished with two washers, Nickel Plated and Polished.

Single Circuit Open.....$0.65 Double Circuit Closed.....$0.90
Single Circuit Closed..... 0.75 Single Filament Control..... 1.00
Double Filament Control, $1.25

TRADE SATURN MARK

Write for catalog and discounts. Amateurs: If dealer cannot supply, order direct

THE SATURN MFG. & SALES CO., INC.
48 Beekman Street Dept. R. N. New York City

RADIO "A" & "B" STORAGE BATTERIES CHARGED AT HOME, FOR FEW CENTS, WITH A "PATENTED FULL WAVE" 100-130 Volt 60 Cycle A. C. AUTOMATIC MAGNETIC

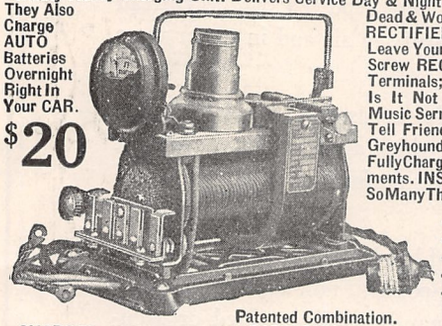
F-F RADIO RECTIFIER

Eventually You Will Buy An F-F RECTIFIER. Why Not Now? The Sooner You Buy It; The More You Save

It CHARGES All 6 Volt RADIO "A" & AUTO Batteries; & All RADIO "B" & LOUDSPEAKER Storage Batteries Up To 120 Volts In Series Inductively At Home Overnight. Disconnecting & Multiple Connections Unnecessary. Charging Circuits Separate. Nothing Like It Made. No Chance For Grounds Or Short Circuits. No Skill Required. AMMETER Eliminates Guess Work. It Costs You Less To Buy An F-F RECTIFIER than To Be Without One. You PAY for ONE Whether You Buy One Or Not, for it Costs An Average Of $2. for Charging & Rentals Every Time An Auto Battery Is Charged By Others, but Only A Few Cents When You Charge Your Own From A Lamp Socket With An F-F Battery Boosting RECTIFIER. If You Have Never Known The Delightful Feeling Of Having Your Storage Batteries Always Fully Charged for RADIO & AUTO You Will Experience A New Thrill When You Have A RECTIFIER of Your Own Which Gives You A Fully Charged Battery Overnight At A Cost of A Few Cents & A Pleasant Feeling Of Things Well Done. Those Who Own Them Feel Their F-F RECTIFIER is Their Faithful Friend. It Charges Automatically & Being Clean Can Be Placed Anywhere. Nothing To Slop Over Be Filled Burn Out Need Attention Or Cause Trouble. Both Waves Are Rectified Thru Infusible Carbon Rectifying Brushes, Maintaining Constant Efficiency Uninterruptedly. While Its FULL WAVE Delivers RAPID TAPER CHARGE recommended By All Storage Battery Manufacturers. The F-F RECTIFIER is A Complete Compact Portably Handy Charging Unit. Delivers Service Day & Night Automatically. Will Charge Dead Battery. Do Not Think Battery is Dead & Worn Out Simply Because It Will Not Start Your Car. Buy an F-F RADIO RECTIFIER & Fill it With LIFE. It SAVES MORE than Its Cost & Lasts A Lifetime. Leave Your Battery In Car, Or Where Ever It Is, Without Even Disconnecting It. Screw RECTIFIER Plug In Lamp Socket Snap RECTIFIER Clips On Battery Terminals; Turn Switch & Battery Will Be Charged In Morning At Cost Of Few Cents. Is It Not Gratifying To Be Ready For All RADIOPHONE BROADCAST Music Sermons & News When Friends Call? Never Having To Be Careful Of, or Tell Friends Your Batteries Are Dead & to Feel Your Car Respond Like A Greyhound, Spinning Engine With Power When You Throw In STARTER? Fully Charged Batteries By Starting Car Quick Require: Fewer Expensive Replacements. INSIST on The F-F RECTIFIER. Built By A Master Of The Art in 7 Types. So Many Thousands Are Being Sold It Has Made Possible These POPULAR PRICES

They Also Charge AUTO Batteries Overnight Right In Your CAR.

$20



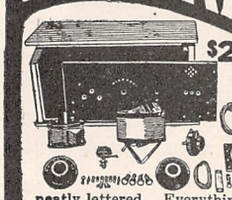
Patented Combination. CHARGES AUTO & RADIO BATTERIES

TYPE 6 Charges 6 Volt Radio "A" & Auto Batteries At 6 Amperes..$15
TYPE B Charges Radio "B" Storage Batteries Up To 120 Volts..$15
Type A-B Combination Charges "A&B" Radio & Auto Batteries..$20
Type 12 Charges All 12 Volt Batteries At 5 Amperes.....$15
TYPE 166 Charges All 6 Volt Batteries At 12 Amperes.....$20
TYPE 1612 Charges All 12 Volt Batteries At 7 Amperes.....$20
TYPE 1626 Is A Combination Of TYPES 166 & 1612.....$28
ALL TYPES BUT "B" CHARGE AUTO BATTERIES.

The Large TYPES are Recommended For Heavy Batteries, or Where Time Is Limited. SHIPPING WEIGHTS Complete With AMMETER & BATTERY CLIPS 11 to 15 Lbs. Purchase From Your Dealer Or Mail Check for Prompt Express Shipment. If Via PARCEL POST have Remittance Include Postage & Insurance Charges, or WRITE Us To Ship TYPE Desired C. O. D. Other F-F Battery Boosters Charge Batteries From Farm Lighting Plants & D. C. Circuits & for GROUP CHARGING Economy Use Our 8 Ampere 12 Battery Capacity Automatic Full Wave F-F ROTARY RECTIFIER described in ROTARY BULLETIN 32A. ORDER Now, or WRITE Immediately for FREE Descriptive RADIO & AUTO BOOSTER & ROTARY BULLETINS 32A & 32

FRANCE MFG. CO. General OFFICES & WORKS: CLEVELAND, OHIO, U. S. A.
Canadian Distributor: The Jack V. Elliot Co., Hamilton, Ontario, Canada.

BUILD YOUR OWN RADIO



$20 Save $8 Money

Complete parts ready to assemble, Panel drilled and neatly lettered. Everything complete with full instructions. Screw driver and pliers are all tools needed. Shipped prepaid. Send your order today. Illustrated folder on request. With each set we give FREE the $3.50 LeFax Radio Handbook.

WAVELAND RADIO COMPANY (Inc.)
1348 N. Clark St., Dept. , Chicago, Ill.

Super-Sensitiveness!

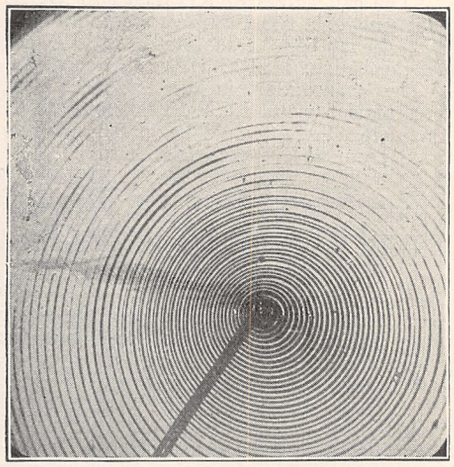
THE crystal is the "bull's-eye" of your crystal receiving set. Unless it is super-sensitive you are wasting time and entertainment and cannot "hit" the combination for best results. Insist upon the genuine original Arlington Tested NAA Detector Minerals. They are carefully selected from bulk stock, individually tested and guaranteed super-sensitive.

Galena, Silicon or Goldite price per crystal, 25c. Same mounted in brass cup, 40c. Obtainable at your dealer's or sent direct (post-paid) on receipt of price.

The Newman-Stern Co
Newman-Stern Building Cleveland

Money for You Add to your Salary—Make Extra Pin Money. Start a lucrative business of your own. Spend an hour each day taking subscriptions for the "Radio News." We'll pay you well and you'll enjoy the work. Write for full particulars. Circulation Dept., RADIO NEWS, 53 Park Place, N. Y. C.

in the disc in front of the lantern objective lens, we shall see on the screen an image of a set of concentric annular ripples, which will appear to be stationary or can be made to expand slowly outwards by properly adjusting the speed of the stroboscopic disc (see Fig. 9).



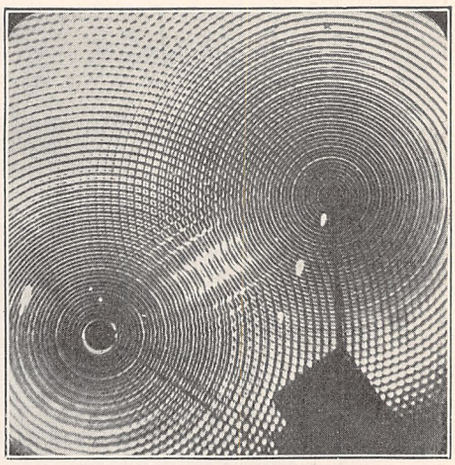


Fig. 9—Photographs of Capillary Ripples on Mercury Created by Impacts of Prongs of a Tuning Fork.
Photo by J. H. Vincent

With this appartus we can show a number of instructive experiments. If we arrange two dropping tubes so as to drop water at places an inch or two apart in the tank and adjust the drops so that they fall simultaneously, then we shall see on the screen a complex pattern of ripples. Each set of drops makes its own concentric set of annular wavelets. It will then be clear that at certain places the humps of one set of waves will coincide with the humps of the other set, and the elevation of the water at those places will be increased. In the same way the hollows or depressions of one set will be in coincidence with those of the other, and will increase the depression. On the other hand there will be some places lying along certain lines at which the humps or crests of one set of waves will coincide with the hollows or troughs of the other set, and hence at these places the waves will extinguish or nullify each other. This effect is called the *interference* of waves, and is of great importance in wave phenomena in general (see Fig. 10). In fact, whenever we can obtain evidence of interference we can say with almost complete certainty that we are dealing with a case of wave motion. In our lantern tank experiment the lines along which interference is taking place from waves diverging from two centers are lines which are parts of curves called hyperbolas, because it is a property of such

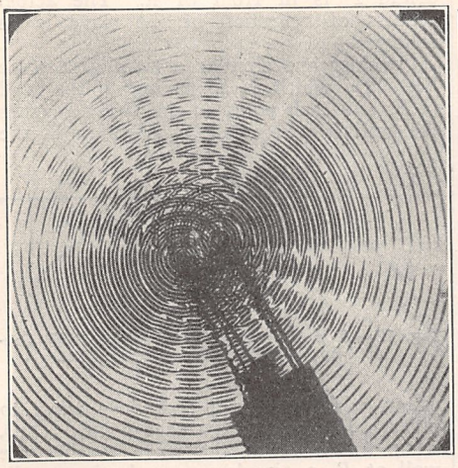


Fig. 10.—The Interference of Two Sets of Circular Capillary Wavelets. The White Portions in the Diagram are the Places in Which the Two Sets of Waves Have Interfered and Destroyed each Other.—Photo by J. H. Vincent.

a curve that the difference of the distance of any point on the curve from two fixed points called the foci is constant. The condition of interference is that the distance of the point at which it takes place from the two wave sources must be a certain odd multiple of half a wavelength, and, moreover, the waves must start in the same phase at the same instant from the two sources.

Another effect well shown by this ripple appartus is the reflection of a wave. For this purpose we put into the shallow trough a little flat wall of metal which stands up above the water a little. The dropping point is arranged at a little distance from this wall so that the miniature waves strike against it like sea waves on the coast striking a sea wall. We then see on the screen a double set of ripples, one set approaching the wall and another set moving away from it. This second set appear to diverge from a point as far behind the wall as the actual source point is in front of it. The reason for this will be evident on looking at the diagram in Fig. 11.

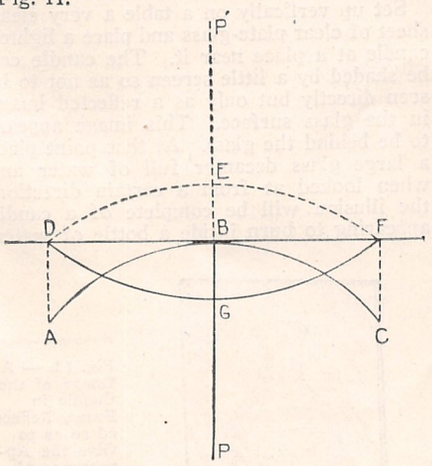
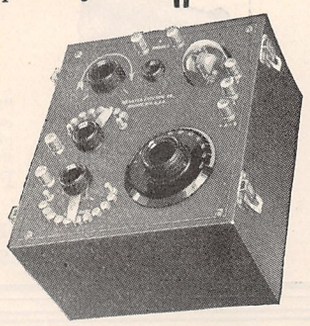


Fig. 11.—Illustrating a Wave Reflected from an Obstruction.

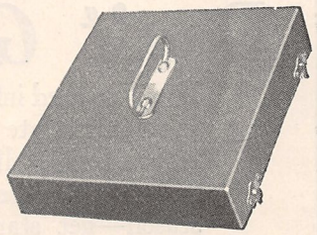
Let *P* be the origin from which the waves diverge and let *A B C* represent the crest of one annular wave just reaching the wall *D B F*. If the wall did not exist that wave would move onwards and an instant later would be found in the position *D E F*, which is part of a circle whose centre is at *P*. Since, however, all parts of the wave *A B C* are turned back or reversed in motion on striking the wall, the actual reflected wave is found at *D G F*. It is obvious that this is part of a circle whose center is at *P*, which is a point as far behind the wall *D B F* as the actual

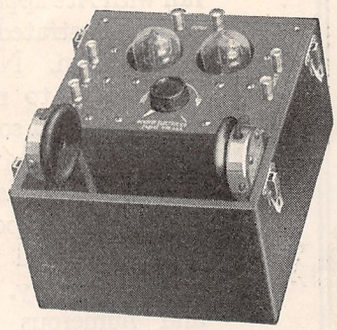
Unusually Good Reception With a Low-Priced Set

Long range, a high degree of selectivity and unusually clear-toned reception! This is what we offer the radio-buying public in our new 2A single tube receiving set selling at $30.00 (less head set and tube). This is an ideal set for local broadcasting and for distances up to 50 miles. Under favorable conditions, powerful stations located 150 to 200 miles distant can be received. This accurate tuning is obtained by tapped primary and secondary inductances and a variable condenser. The wave length is from 150 to 600 metres.



With this set, when combined with our 3B Audio Frequency Amplifier Unit—also illustrated on this page—you can tune in many stations far beyond the range of the average low-priced set. Here, in our own laboratory at Racine, under ordinary weather conditions, and with an average sized outside antennae, we have successfully received from WJZ, the Westinghouse station at Newark, N. J., WSB, the Atlanta Journal station at Atlanta, Ga., as well as KDAK at East Pittsburg, KSD at St. Louis and WHB at Kansas City—reception that is impossible of attainment with the ordinary low-priced set. The 3B Audio Frequency Amplifier Unit sells for $27.50 (less head set and tubes).



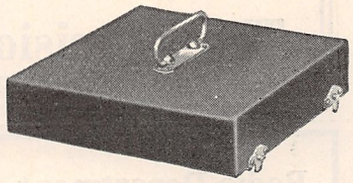


WEBSTER
RADIO APPARATUS

Webster Head Sets

Webster Head Sets are conspicuous for their appearance, great comfort and fine tone qualities. They embody typical Webster construction and will add greatly to the efficiency of any set. They are 2,500 ohm resistances and list for $7.00.

Ask your dealer about Webster Receiving Sets and Webster Radio parts. If he cannot supply you, write for our 24 page catalog and order direct.



WEBSTER ELECTRIC COMPANY
RACINE WISCONSIN U.S.A
Dept. B

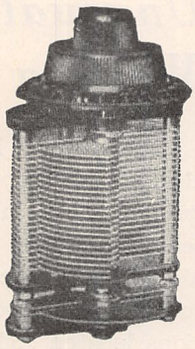
Manufacturers of Webster Magnetos.

Over 750,000 now in use.

"UNITED"

VARIABLE CONDENSERS
Are "Just About Perfect"

In outward beauty—with clean-cut hard aluminum plates, ebony Bakelite ends, **highly** finished nickeled parts and, in the "beautiful" **work** they do—"United" Condensers are as near 100% good as can be imagined.



Vernier Type (Like cut)

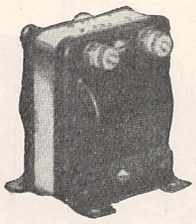
Only Vernier with Stop—complete with knob and dial; postpaid:

46 plate.....$6.50. 26 plate.....$5.50

Plain Type

(Without vernier, dial or knob)

43 plate $4.50	5 plate $2.75
23 plate 4.00	3 plate 2.25
11 plate 3.50	Postpaid



Pat. Applied For

"UNITED" Audio Frequency Transformers

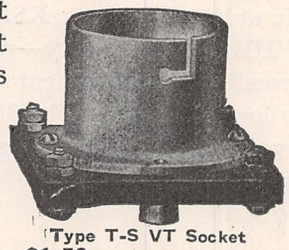
"Staple as Wheat" in the radio industry. Magnetically shielded, in a shell of original design and finish—a beautiful piece of workmanship. Ratio 5 to 1. Insures loud, clear signals. Fully mounted.

Price, postpaid $4.50

United Manufacturing & Distributing Co.
536 Lake Shore Drive **CHICAGO**

Don't Growl—

If you've used inferior equipment, and can't get results. It's not too late to throw it out and start over—with *Ace* material. If you have put up with poor service the past season—get started right this fall with *Ace* apparatus. Our socket illustrated herewith is a suggestion. Not a molded proposition to melt at the first touch of a soldering iron, but a base of ¼" solid sheet Formica, with die cast shell and absolutely guaranteed. Grid leak incorporated in socket base—adjustable to suit tube—and the price as low as consistent with highest quality. We make complete receiving sets and numerous small parts—literature on request.



Type T-S VT Socket
$1.50 with Grid Leak

ADDRESS DEPT. H-P

The Precision Equipment Company

2437-2439 GILBERT AVENUE, CINCINNATI, OHIO

Radio Department. Will lease space for a radio sales department in our retail store, Cleveland, Ohio, on percentage-of-sales basis or flat rental. Apply The Starr Piano Co., 1224 Huron Road, Cleveland, Ohio.

Don't Wear a Truss

BE COMFORTABLE—

Wear the Brooks Appliance, the modern scientific invention which gives rupture sufferers immediate relief. It has no obnoxious springs or pads. Automatic Air Cushions bind and draw together the broken parts. No salves or plasters. Durable, Cheap. Sent on trial to prove its worth. Never on sale in stores as every Appliance is made to order, the proper size and shape of Air Cushion depending on the nature of each case. Beware of imitations. Look for trade-mark bearing portrait and signature of C. E. Brooks which appears on every Appliance. None other genuine. Full information and booklet sent free in plain, sealed envelope.

BROOKS APPLIANCE CO.,
218-B State St., Marshall, Mich.

WANTED—Back numbers of Radio News, Sept., Oct., Nov. and Dec., 1921, Jan. and Feb., 1922. Experimenter Publishing Co., 53 Park Place, New York City.

origin *P* is in front of it. The actual process of reflection of the wave is as follows:—

Consider one circular crest *A B C* (see Fig. 12), which is advancing to the wall *D F*. As each point on that wave reaches the wall it will create a vibration in the

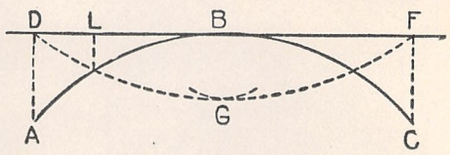


Fig. 12.—A Resultant Reflected Wave DGF Created by Wall DBF Obstructing ABC.

water, which causes a secondary wave to diverge in circles from that point. Thus, when the front of the wave touches the wall at *B*, a circular wave begins to diverge from *B*. A little later a point *M* on the wave reaches the wall at *L*, and from that point another secondary disturbance originates. Similary, when a point *A* on the original wave reaches the wall at *D*, it gives rise to a secondary wave diverging from that point. The wave originating at *B* gets the start over that originating at *L* and that at *L* over the wave starting from *D*.

The line *D G F* (dotted) which touches all these secondary waves at any instant is called their *envelope* and is the resultant reflected wave. Everyone knows that in the case of a reflected image in a looking glass, the image of the object appears to be as far behind the mirror as the real object is in front of it. This is simply a consequence of the fact that the reflected image is caused by light which diverges in spherical waves of a certain kind from every point on the object, and the observer into whose eyes these reflected rays enter sees the image as a collection of radiant points, each of which appears to be as far behind the mirror as the corresponding radiant point in the object is in front of it.

Many optical illusions and conjurors' tricks depend upon this principle. Thus, for instance, we can easily create the illusion of a candle appearing to burn inside a decanter of water as follows:—

Set up vertically on a table a very clean sheet of clear plate-glass and place a lighted candle at a place near it. The candle can be shaded by a little screen so as not to be seen directly but only as a reflected image in the glass surface. This image appears to be behind the glass. At that point place a large glass decanter full of water and when looked at from a certain direction, the illusion will be complete of a candle appearing to burn inside a bottle of water.

Fig. 13. — An Image of the Candle in Front, Reflected so as to Give the Appearance of Being Within the Decanter Full of Water Behind the Sheet of Glass.

Another important property of surface waves and of waves in general can be demonstrated by the same appartus, viz., the refraction of waves.

If we have a set of parallel plane or straight waves which are moving in one material or medium and advancing in an

inclined direction to a straight boundary between that medium and one in which the waves move with a different velocity, then on crossing the boundary the direction in which the waves are advancing is changed. Thus, let *AB* be the crest line of a straight wave advancing parallel to itself towards a boundary line *DF* between two media 1 and 2. Let us suppose that the waves travel more slowly in medium 2 than in medium 1. Then when the left-hand end *A* of the wave *AB* passes the boundary it will proceed more slowly (Fig. 14). Hence it will only have reached a

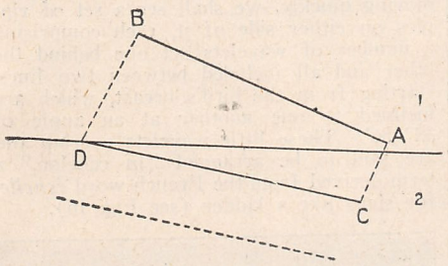


Fig. 14.—A Diagram Illustrating the Refraction of a Wave.

point C and traveled a distance *AC* in the time that the right-hand end *B* will have traveled over a greater distance *BD* and reached the point *B*. Therefore the line of the wave front, viz., *AB*, will be slewed around into CD on crossing the boundary into the position *DC*. This is called the *refraction* or bending of a wave.

It is this bending of the wave front when passing across the boundary of two media in which the wave has different velocities which determines so many familiar optical phenomena such as the apparent bending of a stick when placed half immersed in an inclined position in the water.

The refraction of ripples can be shown with the above described lantern apparatus as follows:—

A semi-circular thick sheet of glass is provided which fits into the lantern tank and makes one-half of it more shallow than the other. One dropping tube is arranged so as to send out ripples from a point in the deeper part of the tank. These ripples spread out in circular rings. If the water level is adjusted so that over the shallow part of the tank it has a very slight depth, not more than a millimeter or so, then over this part the ripples will travel more slowly than over the deeper portion. Hence, when the ripples pass over the boundary line it will be seen, on regulating the speed of the stroboscopic disc as above described, that there is a discontinuity or change of direction of the expanding annular ripples. On the shallow

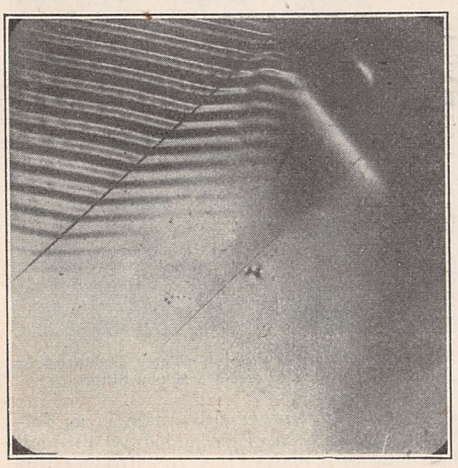
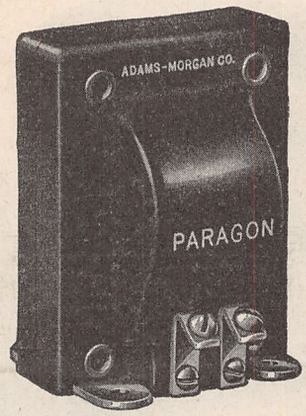
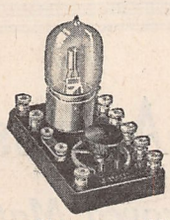


Fig. 15.—Showing the Refraction or Bending of Waves in Passing Over from One Medium to Another in Which They Have a Different Velocity of Propagation.—Photo by J. H. Vincent.

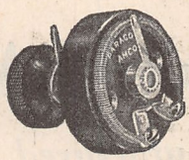


New Paragon Audio-Frequency Amplifier Transformer
$5.00

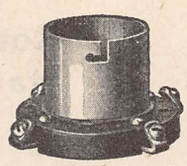
Specially designed for reception of radio telephone signals. Reduces tone distortion. Chokes out vagrant currents that cause scratching, hissing and hollow tones. Gives the soft, full, well-rounded tones essential for good radio telephone reception. May be mounted on either panel or base. Has four terminals conveniently arranged and marked for connection. Completely housed in polished condensite shell. No. 81.

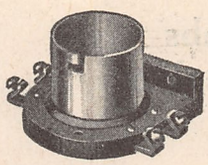


Paragon V. T. Control No. 70
Attractive—compact—efficient
$6.00

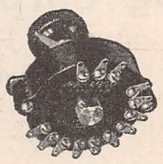


Paragon Rheostat No. 25
Panel or Table
rugged—dependable—smooth action
$1.50

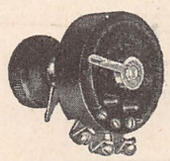




Paragon V. T. Sockets
Perfect contacts—heatproof—mirror finish—non-breakable
Standard No. 30 $1.00
Universal Mounting No. 32 $1.25



Paragon Stage Control Switch No. 90
Positive—noiseless—rapid—ideal
$3.00



Paragon Potentiometer No. 35
300 ohms—economical—rugged
$1.75

An illustrated Catalog of Paragon Radio Products is yours for the asking.

DEALERS—The Adams-Morgan Company has an interesting proposition to make to reputable radio dealers who believe in quality merchandise. Details on request.

ADAMS-MORGAN COMPANY, Alvin Ave., Upper Montclair, N. J.

PARAGON

Reg. U. S. Pat. Off.

RADIO PRODUCTS

"SIGNAL TRIUMPH"

COUPLER-METER

THIS instrument marks a new stride toward the ultimate in Radio perfection.

It is a combination of vario-coupler and variometer; it is simplicity itself; it is efficient to a surprising degree; there are no taps, no solder and no complications.

DEALERS—Stock it now—there is no end to the demand. Retails at $6.50, including 3-in. dial.

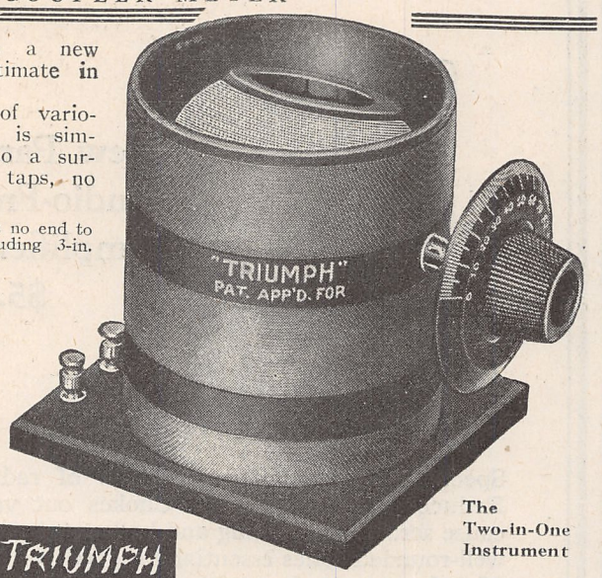
Sample will be sent on memorandum to any rated concern, upon request.

We also manufacture complete V. T. Receiving Sets, with or without amplification, fixed and variable condensers, dials, V. T. sockets, binding posts, etc. Write for discounts and full details.

DO IT NOW!

If your Dealer cannot supply you, order direct.

TRIUMPH



The Two-in-One Instrument

SIGNAL RADIO & ELECTRIC CORP. 64 UNIVERSITY PLACE NEW YORK CITY

Moulded-RADIO-Accessories

Manufactured of Approved Material

Specifications Solicited

Knobs Dials Rotors
Couplers Panels Stators

International Insulating Corporation

Radio Dept.
25 West 45th St.
New York City

Factory
Springfield,
Mass.

The Newest Book on the Newest Subject

INCREASING RADIO EFFICIENCY

Through

SUPER-REGENERATION

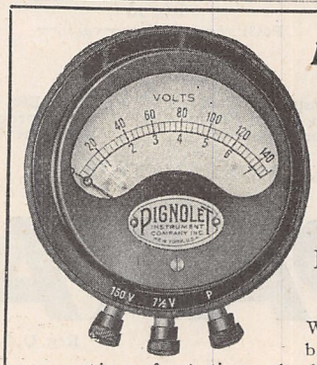
A direct, simple explanation of the newest radio invention; its methods, circuits and operation. Complete and thoroughly practical. First article of this kind published

$1.00

At Bookstores, Radio Stores or by Mail

RADIO CONSULTATION BUREAU

Plymouth, Mass.



Pignolet
RADIO VOLT-METER

One Instrument Makes All Tests

Write for booklet with suggestions for testing and adjusting Radio Sets.

Pignolet Instrument Co., Inc.
116 Liberty Street, New York, N. Y.

part the form and curvature of the ripples is such that they appear to diverge, not from the actual dropping point, but from another point situated a little way from it (see Fig. 15).

7. WAVES PRODUCED BY SHIPS

In concluding this part of our subject, attention may be directed to a very important class of surface waves on water, viz., those made by ships, boats and aquatic animals in moving over the surface.

If we look at any swan or duck, swimming on a pond, especially if the bird is moving quickly, we shall see a set of ripples on either side of it, each comprising a number of wavelets set one behind the other and all included between two lines, starting from the bird's breast, which are inclined to one another at an angle of 38° 56′. These little wavelets overlap and are said to be arranged "in echelon," a term derived from the French word *échelle*, for steps like a ladder (see Fig. 16).

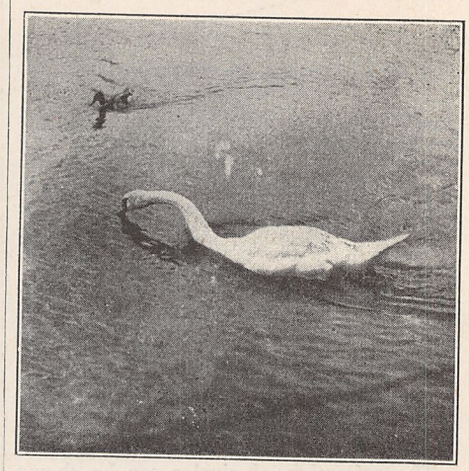


Fig. 16—Echelon Waves on Water Produced by the Motion of a Swan.

They are probably best seen when a boy's model ship is sailing over smooth water on a pond, and it will then be noticed that in addition to the echelon waves, which start from the bows, there is another set of transverse waves behind the ship. In fact, the echelon waves and transverse waves all form part of one complete system of ship waves (see Fig. 17).

This system of waves above mentioned is all included between two inclined lines, which start from the ship's bows. A con-

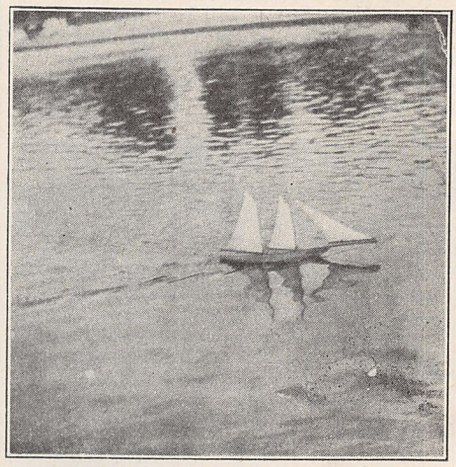


Fig. 17—Echelon Waves on Water Produced by the Motion of a Boy's Model Ship.

struction which gives this angle is as follows:—Describe a circle and draw through its center C a diameter $A\,B$. Produce this line $A\,B$ to a point S, so that the length $B\,S$ is equal to $A\,B$. Then from the point S draw two lines, called tangents, to touch the circle at points D and E. Then the

angles *D S B*, *E S B*, are each 19° 28′, and the angle *D S E* is 38° 56′ (see Fig. 18).

Let us consider for a moment how these waves are formed. When the ship moves

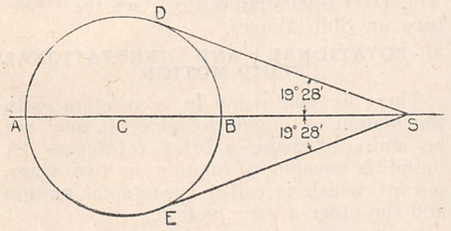


Fig. 18.—A Line Construction Illustrating the Angle of Waves Produced by the Bow of a Moving Ship.

forward through the water it gives a push to the water which creates an elevation and starts a wave. This push being continually repeated as the ship progresses creates a group or family of waves. One of these waves may be considered to be attached to the ship's bows, and to move forward with it. It has already been pointed out that in the case of surface waves on water the velocity of a group of waves is half that of a single wave. Hence, if when the ship is at *A* it starts a group of waves the middle point of this group will have traveled only as far as *B* by the time that the ship itself, carrying one wave with it, has traveled double that distance and arrived at *S*. Hence we see that a ship moving over the water is followed by an ever-lengthening train of waves, the group velocity of which is half that of the ship.

The subject of wave production by ships is of enormous practical importance, because the creation of waves absorbs or requires an expenditure of energy. In the case of a steam, petrol or electric ship that energy is derived from the coal, petrol or other source of driving power. Hence, other things being equal, the less the ship makes waves the less the dissipation of energy. Great attention has therefore been given to the design of ships' hulls with the object of determining what form has the least wave-making quality.

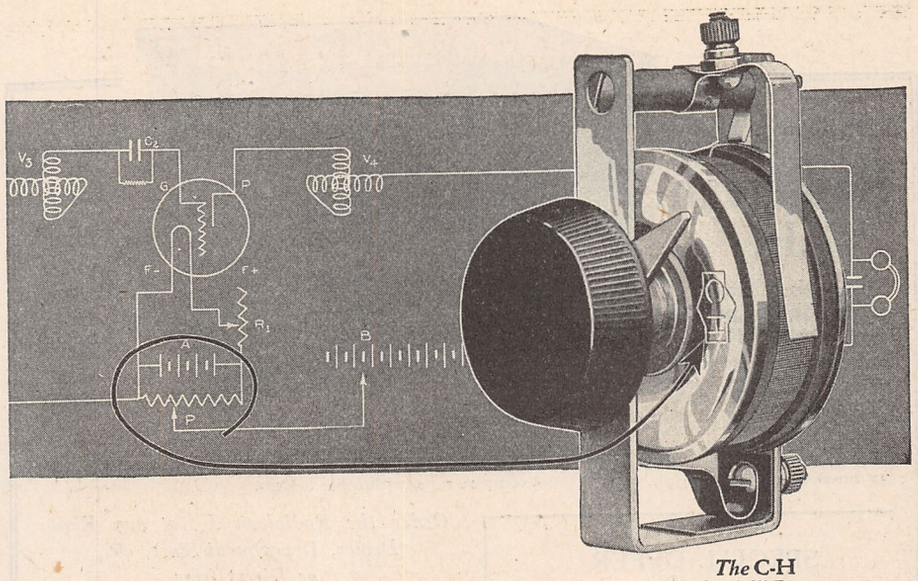
All the power taken up in wave-making travels away from the ship and is wasted, and hence to obtain the greatest speed for the least expenditure of propelling power, the form of the ship must be such as to create surface waves as little as possible.

In addition to the power absorption in wave-making there is also an expenditure in making eddies or little vortices in the water, and at low speeds the chief source of energy waste is in overcoming frictional resistance between the water and the hull of the ship.

This last can be reduced by making the hull smooth, and also free from projecting studs or rivet heads, all of which also tend to create eddies in the water and increase the skin resistance and therefore energy loss. It is now the custom to predetermine the effects of any proposed form or design of ship hull, on the power required to drive it through the water at a given speed by means of experiments made on large scale models dragged through the water in a very long tank called a testing tank. The models are made to scale in paraffin wax, as this material can easily be shaped to any required form and then melted down and used over again.

The model is then dragged through the water in the tank at a given speed, and by means of a sensitive recording dynamometer the power exerted is exactly measured.

As the subject of ship design is not one with which we are here concerned the mode of conducting these tank experiments need not be discussed. The reader who desires more information may be re-



The C-H *Radio "A" Battery Potentiometer*

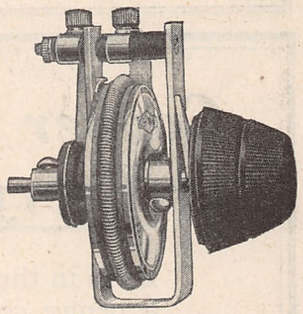
Another Opportunity to Demand C-H Protection

The C-H trade mark has made its place in the history of radio. More than a quarter million rheostats engraved with this mark of the master builder of rheostatic control apparatus are today giving satisfaction to an army of enthusiasts.

The new "A" Battery Potentiometer gives the same assurance of satisfaction in any equally vital part of your receiving circuit—the same assurance that has for more than thirty years made engineers the world over demand the C-H trade mark for protection.

This new potentiometer matches exactly the C-H Radio Rheostats in both appearance and performance. It is of the revolving drum type with a total resistance of 300 ohms. It is designed for panel mounting and finished in satin nickel and ebony black. A comfortable knob of genuine Thermoplax and a highly nickeled pointer provide easy and positive control.

To be certain of results demand the C-H trade mark—it is your guarantee of satisfaction.



C-H Radio Rheostats

Built by Rheostat Builders

Built with the same care and precision that has made the C-H trade mark the guarantee demanded by engineers for the last thirty years. More than a quarter million now in use. Finished in satin nickel and ebony black. Panel mounting with binding posts for easy wiring. Large comfortable knobs of genuine Thermoplax. Positive travel stops with "full on" and "full off" positions. Guaranteed mechanically and electrically perfect by the master builders of all rheostatic control apparatus.

Type 11601-H1
(with vernier) $1.50
for detector tube control

Type 11601-H2
(without vernier) . . $1.00
for amplifier tube control

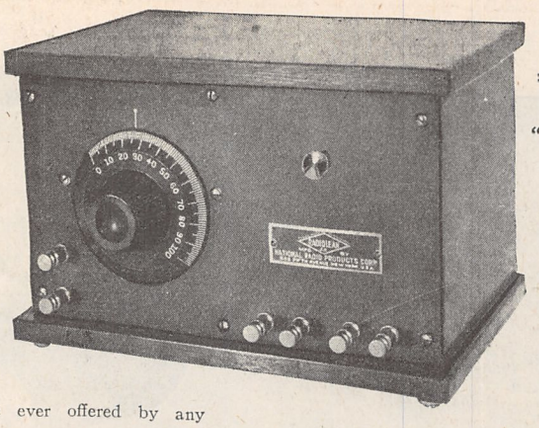
THE CUTLER-HAMMER MFG. CO.
Member Radio Section, Associated Manufacturers of Electrical Supplies
MILWAUKEE · WISCONSIN

Over a Quarter Million **C-H** *Radio Rheostats Now in Use*

C-H RADIO "A" BATTERY POTENTIOMETER

Here's the Radiolean Jr.

Everybody wants this popular price Radio Set



The "Radiolean Jr." PRICE **$12.50** without Headset **$15.00** with Headset

Looks like a Detector Tube Set and can be changed into one at small cost. The Biggest Value ever offered by any Radio manufacturer.
This wonderful crystal receiving set is being sold for $12.50 retail price which includes all equipment except phones. Head phones from $3.00 upward. Get our prices on any radio goods you need and compare same with other dealers.

SPECIAL OFFER

WESTERN ELECTRIC HEAD-SETS (Army type)	$7.50
U. S. NAVY TUBES (Amplifying, Detector and Transmitting)	$4.25
PORCELAIN RHEOSTATS Each	35c

Order the Radiolean Jr. at any Radio Dealer, Department Store, etc., or Direct from

NATIONAL RADIO PRODUCTS CORP.
509 Fifth Avenue
New York

Copper is Essential in Every Outfit

Even in the least expensive radio outfits, where a penny counts in figuring up costs, *Copper* is specified for aerials.

Copper being the best conductor of electricity, it is the metal that can be depended upon to carry the signals with the greatest strength and clearness.

Wherever electricity is to be conducted, USE COPPER.

COPPER & BRASS RESEARCH ASSOCIATION
25 Broadway - New York

U. S. A. SIGNAL CORPS RADIO APPARATUS RELEASED

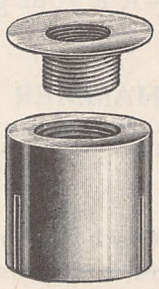
194-W Western Electric Aviation Type Phones, complete with Sponge Rubber Ear Cushions, Headband and Aviator's Helmet; 2200 ohms; 22000 ohms impedence..... $7.95 Per Pair

Signal Corps Super-Sensitive Microphone Transmitter. Operates with Local Battery from 4 to 22 Volts. $2.45

Large Soft Sponge Rubber Ear Cushions. When applied will make any Headphone sound-proof and more comfortable; aviation type.... 50c Pr.

Izenstark Radio Co.
509 S. State Street CHICAGO, ILL.

ATTENTION RADIOTICS



IF you use Amplifying Tubes you can make your Victor talking machine a RADIO LOUD SPEAKER, with a

"BEEKO"
Radio-Phone attachment

Liberal Discount in Quantities

J. H. Bunnell & Co.
Department X 6
32 Park Place, New York

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year. Experimenter Publishing Co., 53 Park Place, N. Y. C.

ferred to the author's book, "Waves and Ripple in Water, Air, and Aether" (published by the S.P.C.K.), or to Lord Kelvin's "Popular Lectures and Addresses," Vol. III (Macmillan & Co.), see the "Lecture on Ship Waves."

8. ROTATIONAL AND IRROTATIONAL FLUID MOTION

There is one point in connection with the motion of liquids to which it may not be amiss to make a brief reference. A liquid is capable of motion in two ways, one of which is called *irrotational* motion and the other *vortex* motion.

In the irrotational motion every particle of the liquid moves without rotation. If we imagine any small spherical portion of the liquid to become solidified, and that we could make a mark on this little solid sphere, and watch it as it moves with all the rest of the liquid we should find the marked spherule moving so as always to keep its marked end pointing in one constant direction. In other words, although it may possess a progressive motion, it is not revolving in any way, or has no rotational motion. On the other hand, if the motion of the liquid is such that the selected spherule turns round continually so as to face in different directions as it progresses, and as the moon does in revolving round the earth, then the motion is called rotational. If the liquid particles rotate so as always to face towards a certain line called a vortex line, then this motion is called vortical.

We can see a vortex of water formed every time we pull up the waste-plug of a bath or wash-hand basin full of water. The water swirls round, forming what is called a whirlpool or eddy, or vortex, in which a certain part of it is revolving round an axis rotationally. A vortex in a liquid must either have its two free ends on the liquid surface or else it must form an endless vortex or vortex ring.

We can see the former type of vortex formed by drawing a teaspoon, with the bowl half immersed, quickly through a cup of tea. On the edge of the spoon will be noticed two little whirlpools of liquid which move with the spoon. These are the ends of a vortex which extends from one whirlpool to the other round the edge of the immersed part of the spoon.

On the other hand, we see an endless vortex produced in those rings which many cigarette smokers can blow from the mouth or end of the cigarette.

In this case the smoky air is revolving around a circular or closed line in such fashion that the motion on the inside of the ring is in the direction in which the ring as a whole is moving forward.

They can better be made as follows:—Make a little cubical paper box of rather stiff paper, the side of which may be 3 or 4 ins. in length. Cut a circular hole about 1 or 1½ ins. in diameter in the center of one side (Fig. 19). Fill the box with tobacco smoke by puffing a cigarette into it. Then give a smart tap on the side of

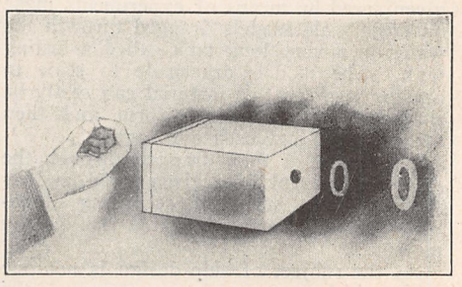


Fig. 19.—Circular Vortex Waves Produced by Tapping the Back of a Paper Box Filled with Smoke Are Shown Making Their Exit Out of a Hole in the Front.

the box opposite to the hole. A smoke ring will emerge and fly through the air. A careful examination of the ring as it moves will reveal the peculiar kind of rotary motion which is taking place in the ring. The smoke merely makes evident the air motion, but the vortex ring is produced and exists when the box is tapped, whether it is full of smoke or not. We have such vortex rings produced whenever a jet of gas or liquid moves through an undisturbed mass of gas or liquid.

(*To be continued in March issue*)

Mr. and Mrs. Brownlee Hold Hands

(*Continued from page* 1468)

you to see how two reasonable people can get pleasure out of the radio, even if they are man and wife. Hello; look at the time; the fight ought to be beginning."

Mr. Murchison dropped into a chair and Brownlee, with the deft fingers of an expert, manipulated the dials. When he had keyed in at 360 meters the voice of WPX's announcer came from the loud-speaker with admirable distinctness:

"This is WPX, broadcasting the Benk-Coogan fight from the ringside, AKG announcing," said the voice: "The huge auditorium is filled to its utmost capacity; I notice many of the notables of the sporting world present; Butcher Benk has just climbed into the ring—you can hear the cheering. He is bowing to his friends. The louder cheering you hear now is for Farmer Coogan—he has just entered the ring and has thrown off his bathrobe. Both men seem to be in prime condition. Benk is now leaning over the ropes to shake hands with Gus Tubbert, the promoter of the fight. Now Mr. Tubbert is shaking hands with Coogan. Benk's trainer has drawn him into a corner of the ring and is whispering in his——"

"Edward!" said a voice from the doorway somewhat sharply, but Mr. Brownlee did not turn.

"Keep still, please, Sophia," said Mr. Brownlee pleasantly, "the fight is just beginning and we don't want to miss anything."

"Edward," said Mrs. Brownlee a little more sharply, "will you please pay me enough attention to notice who I have with me?"

"Sophia," said Mr. Brownlee, "I don't want to seem rude, but when you talk I can't hear what——"

At that moment a haughty voice from the hall said:

"I think I had better not stay, Sophia dear, evidently your husband is so deeply engaged that he cannot spare time to——"

"Jane! What nonsense!" cried Mrs. Brownlee. "I invited you here to hear Dora Dovell read her poems and you shall not be disappointed! Edward, Mrs. Bimberry has come to hear Dora Dovell read her poems over the radio."

Mr. Brownlee turned and saw Westcote's society leader entering the library.

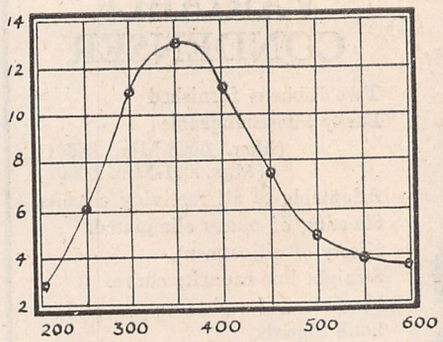
"Butcher Benk and Farmer Coogan have now stepped to their corners. This is WPX, broadcasting from the ringside. Bud Griffin, the sport writer of the *Star*, will now describe the fight for you, round by round and blow for blow. I introduce Bud Griffin——"

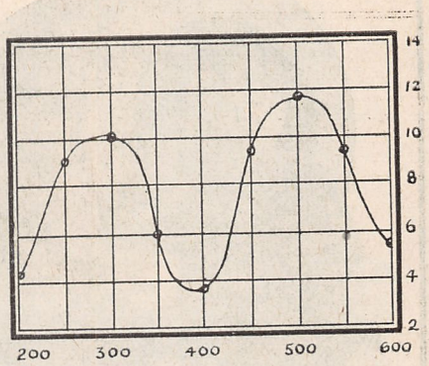
"How-do-you-do, Mrs. Griffin," said Brownlee and hastily corrected himself; "I mean Mrs. Bimberry. Just in time! The fight is just beginning."

It was, indeed.

"Fight!" exclaimed Mrs. Brownlee. "Do you think Mrs. Bimberry has come here to listen to a brutal, cruel prize fight, Edward Brownlee?"

"Sophia," said Mr. Brownlee, "I asked Murchison to come here and listen in this evening. If you think two red-blooded





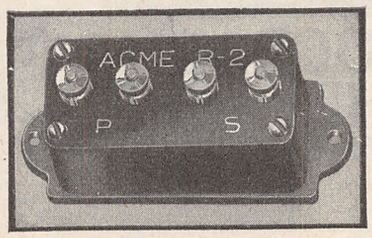
Find this out

before you choose your radio frequency transformers

DOES it have marked depressions and peaks in its amplification range curve between 200 and 600 meters (indicating absence of amplification at the depressions)—or does it keep the amplification range curve uniform with its maximum efficiency around 360 meters—the place you need it most.

A Test

THE two charts above tell a graphic story of tests made on radio frequency transformers in the laboratories of a well known concern. The chart at the left plots the amplification range curve of an Acme R-2 taken from stock. The chart at the right represents a composite plot of the curves of 6 ordinary types of different makes taken from stock. The superiority of the Acme R-2 is self-evident. Note its steadily increasing amplification curve with its maximum at 360 meters—just where it is most needed.



ACME R-2 Frequency Amplifying Transformer
Price $5 (East of Rocky Mts.)

Getting greater distances

EQUALLY important is the greater distances over which you can get broadcasting when using the Acme R-2. The R-2 used in a radio frequency amplifier builds up wave energy before passing it on to the detector. You hear signals that would ordinarily be inaudible. Even the simplest and most elementary type of set, either vacuum tube or crystal receiver type, will have its range tremendously increased when the Acme R-2 is employed in conjunction with a vacuum tube.

The best method

TO secure maximum results over long distances use both Acme *Radio* and Acme *Audio* Frequency Transformers. This insures maximum sensitivity and intensity, quietness in operation and freedom from distortion. A small indoor antenna or loop may be used and sufficient intensity obtained to operate the Acme Kleerspeaker, providing perfect entertainment for a roomful of people.

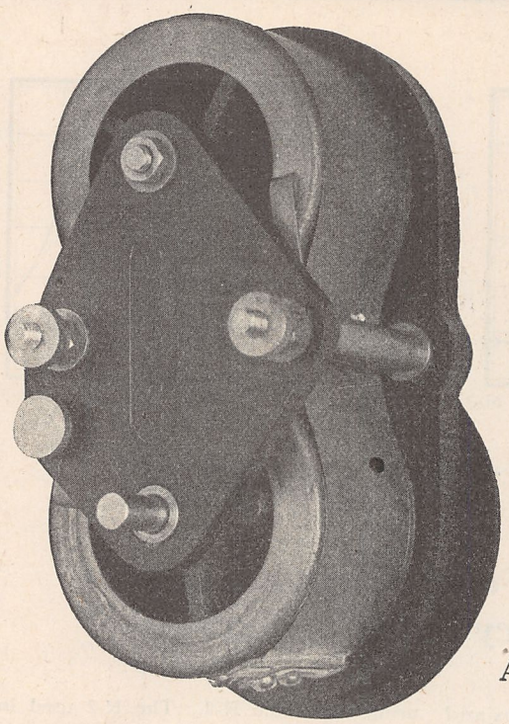
You can get these and all other Acme Products at radio, electrical and many hardware stores.

Write for booklet R-2 showing proper hook-ups and other information.

ACME APPARATUS COMPANY, Cambridge, Mass.
New York, 1270 Broadway
Chicago—184 W. Washington Street

Pioneer transformer and radio engineers and manufacturers

ACME *~ for amplification*



BROOKS VARIABLE CONDENSER

Two Ribbons furnished
Easily interchangeable
(Max. .0005-Min. .00001)
(Max. .001-Min. .00001)
Adaptable to all receiving circuits.
Shorting of plates eliminated.
Nicety of adjustment.
Straight line capacity curve.
Low internal resistance.
Loud Signals.

Jobbers Wanted:

Write for prices and discounts.

Retail Price, $4.75 each
Complete with dial.

Manufactured by

Metric Metal Works
of
American Meter Co., Inc.
ERIE, PA.

Save $4
on the world's supreme Head Set

DICTOGRAPH *Radio* HEAD SET
Was $12-Now $8

NOW you get the world-famous Dictograph Radio Head Set at a clear reduction of $4.00! The tremendous demand has made necessary increased production on a gigantic scale. The new price is only $8.00—for the same supreme Dictograph Head Set that has always sold at $12.00. Made by the makers of world-standard Dictograph products, including the marvelous "Acousticon" for the Deaf, the Detective Dictograph, the Dictograph System of Loud Speaking Telephones.

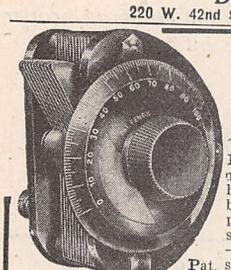
3000 Ohms, for all types receiving sets. Regularly furnished as standard equipment on leading radio receiving sets.

The Standard of the World

DICTOGRAPH *Radio* LOUD SPEAKER
$20

The perfect Loud Speaker for the home. A handsome instrument of superb quality—and only $20, complete with 5 ft. flexible cord. Reproduces every sound in absolutely clear, natural tones.

DICTOGRAPH PRODUCTS CORPORATION
220 W. 42nd STREET (Branches in all principal cities) NEW YORK CITY



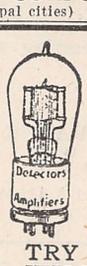
RADIO STORES VARIABLE CONDENSER

Counter weight under dial. Brass studs through aluminum plates. Die cast. Shaft held true center through brass bushings. Binding posts mounted on metal straps. No insulation tapped—inserts throughout. Precision workmanship—best engineering design.

Pat. Pend.

23 Plate, .0005 mfd. Capacity ratio 28 to 1 $4.25
43 Plate, .001 mfd. Capacity ratio 46 to 1 $4.75

IMMEDIATE SHIPMENTS
RADIO STORES CORPORATION
National Distributors and Manufacturers
218-222 WEST 34th STREET
Dept. N. NEW YORK CITY



VACUUM TUBE HOSPITAL

We Repair and Guarantee Them.

Resonable Prices

TRY US ONCE AND YOU WILL TRY US TWICE

Dealers, Agents and Customers Wanted.

G. H. PORELL CO., Inc.,
West Somerville, Mass.

MONEY FOR YOU—Add to your salary—Make extra pin money—Start a lucrative business of your own. Spend an hour each day taking subscriptions for the Radio News. We'll pay you well and you'll enjoy the work. Write for full particulars. Circulation Dept., RADIO NEWS, 53 Park Place, New York City.

men are going to sit here and listen to a wishy-washy poetess read her silly poems——"

"Coogan and Benk shake hands," shouted the radio. "They go to their corners. The gong rings. Coogan jumps to the center of the ring. Benk comes forward crouching. Coogan swings with his right. The blow——"

"—as sweet as buds in April dew
Responsive flows from me to you,
And gentle as a cooing dove
The echo murmurs 'This is love!'"

It was the honey-sweet voice of the peerless poetess, Dora Dovell, for Mrs. Brownlee had touched the dial and changed the wave-length to 400, which was that of the admirable station KZKX from which the peerless poetess was broadcasting. A dark frown gathered on the brow of Mr. Brownlee; he put his hand over the hand of Sophia.

"Let go." he whispered tensely.

"I'll not! I'll not!" whispered Mrs. Brownlee.

"Ah! dearer far than precious stones" (said the poetess)

"I love the song thy voice intones,
And quickly to thy arms I fly
When——"

"Coogan biffs him in the eye," shouted Bud Griffin, as Mr. Brownlee twisted the wave-length back to 360. "Benk uppercuts to the ear. Coogan feints with his left and drives his right to Benk's ribs. They clinch. They break apart——"

"And oh, the parting wrings my heart!" murmured the soulful poetess.

"To part! Ah, this is sad indeed
When closer union is our need,
But still in peace my eyes I'll close
If——"

"Coogan reaches Butcher's nose," shouted Griffin from the ringside; "The Butcher replies with a short jab to the stomach. Coogan spars. Benk rushes——"

"Edward; Edward Brownlee, let go of this dial!" exclaimed Mrs. Brownlee, tugging at it.

"Everybody is becoming excited," declared Bud Griffin from the ringside. "The contestants seem to be angry."

"I'll not let go! I own this radio, don't I?" demanded Mr. Brownlee. "What do you think this is?"

"This is station KZKX," said the radio, "ABJ announcing. The next selection by Miss Dora Dovell, the soul poet, will be——"

"End of round one," declared Bud Griffin, broadcasting at 360 meter wave-length from the ringside.

"I think it is a most shameful piece of behavior, that's what I think, Edward Brownlee," said Mrs. Brownlee. "If I cannot bring a friend to this house——"

"And what about my friend?" demanded Mr. Brownlee angrily. "I've no rights in my own house, I suppose! A nice piece of business if I invite a friend here and set the radio working and you can rush in and cut off what we want to hear and turn on a lot of mush—yes, mush! that's what I said! I said mush, Mrs. Brownlee! A lot of pifflicated poetic mush! It's getting so, nowadays, a man has no rights in his own home——"

"Edward Brownlee! Stop right there! That's enough!

"Round two!" cried Bud Griffin. "Both scrappers still in good condition. As the gong rings——"

"The daisies and the violets
Leap up to greet the Spring," murmured the poet of the soul.

"Slush!" cried Mr. Brownlee bitterly, twisting the dial. "Slush!"

"Edward Brownlee, I will not have you talking that way about Mrs. Bimberry's favorite poetess!" cried Mrs. Brownlee.

"I think, perhaps, I'll go now," said the meek Mr. Murchison.

"You'll do nothing of the kind!" declared Brownlee angrily. "You'll stay, and you'll hear what you came here to hear—a prize fight and not mushy mush! It's about time I showed who is master in this house, once and for all! Sophia, take your hand off that dial! Do you hear me? Once! Twice! For the third and last time——"

"I'll not! I asked Mrs. Bimberry to come here——"

Mr. Murchison got out of his chair and moved delicately toward the door, like a cat walking on ice.

"I really think I'd better be going," he said, coughing his apologetic little cough. "I left my wife all alone—so many burglars about these days—letter to mail—expecting a telegram—really must be getting along——"

In her easy chair the haughty Mrs. Bimberry sat with sternly compressed lips. She did not mean to desert her dear friend Sophia—a member of her own sex—who was doing battle for her. Mr. Murchison might run but she did not mean to run. She cast a glance at Brownlee that let him know quite plainly what she thought of his behavior. Brownlee gave the dial knob one last vicious twist.

"Benk sends a jarring wallop to Coogan's chest," shouted WPX.

"For the third and last time, Sophia, I ask you—will you take your hand from this dial?" Brownlee asked in a dangerously quiet voice. For answer Mrs. Brownlee twisted the dial knob.

"Say Nay, my Soul! Say Nay, my Heart! Say Nay, and ever Nay!" the poetess of the soul responded.

"Very well, then!" said Brownlee, releasing his wife's hand. "Very well! You may have this radio. I give it to you. What I think of this behavior I shall not say, for I am a gentleman. I will leave you to listen to your mushy poetess, Sophia, and you need not wait up for me. I am going to the club, where a man has some rights. But this I will say, Sophia—never, although I live to be a thousand years old, will I listen to a poetess of the soul!"

When Brownlee and Murchison stood in the street their silence was, for awhile, awkward. It did not seem to Murchison that he ought to say anything about the way in which Mr. and Mrs. Brownlee had held hands, and yet he did think he ought to say something for he knew Brownlee must be feeling rather cut up. So he said what he had wished to say all evening.

"Brownlee," he said, "I'm very sorry to have been the cause of this quarrel, because I would have much preferred to hear Dora Dovell. To tell you the truth, Brownlee, she is my favorite poet, and I am passionately—yes, passionately—fond of her poems."

"Great Scott!" exclaimed Brownlee. "If that's so why don't you go in the house again and hear her?"

But Murchison did not go in the house again, and it would not have done him any good if he had gone, for—as soon as the two men had closed the front door—Mrs. Bimberry had spoken to Mrs. Brownlee:

"Let's listen to the prize fight; I'd much rather hear the prize fight, Sophia."

"So would I," said Mrs. Brownlee truthfully.

Radio News Laboratories

(*Continued from page* 1485)

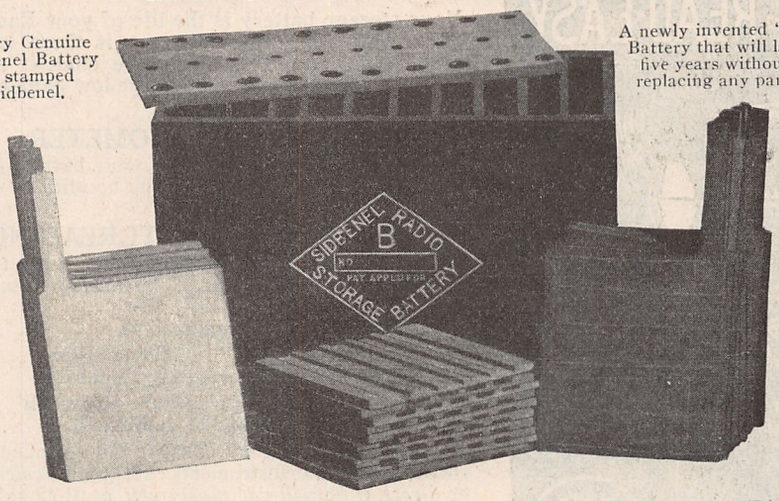
Arrived in good packing with instructions printed on the individual carton.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT No. 54.

THIS "B" BATTERY WILL LAST 5 YEARS

Every Genuine Sidbenel Battery is stamped Sidbenel.

A newly invented "B" Battery that will last five years without replacing any part.



OVER 10,000 SIDBENEL STORAGE "B" BATTERIES have been sold in the last few months. This is conclusive proof that it is the desired radio "B" battery. It will outlast any other type of battery and possesses every known improvement. The patented features include the composition and treatment of the plates, which is entirely different from any other battery. The plates are especially treated with a newly discovered chemical that enables you to draw as low as ten milliamperes without causing the electrical reaction which is a constant internal discharging of the batteries when insufficient current is being drawn from the plates. This self-discharging of the plates, causing the cricking and howling heard in various degrees of loudness in the receivers when using other batteries. It has been proven by actual test that SIDBENEL STORAGE "B" BATTERIES is the only battery that elliminates this electrical reaction.

Each unit is constructed in one piece of hard rubber moulded into ten compartments. Each complete unit is 2½ in. x 3 in. x 1½ in. Note the rigid and substantial construction as shown in the illustration. A special heavy ridge runs through the bottom making it practically unbreakable and enabling us to guarantee it against leakage. The cover is easily detachable allowing you to give the battery a thorough inspection without removing the plates.

A single charge lasts approximately six months. It is recharged in a few hours from A.C. or D.C. lamp socket to its original full capacity.

The enormous amount of energy enables the vacuum tube to make weak signals exceptionally loud and clear. You will notice the wonderful improvement in reception on your first trial.

The units are bottom heavy so that they will not turn over. All the features of the SIDBENEL BATTERY are covered by our patents.

Complete battery weighs only 2¾ lbs.

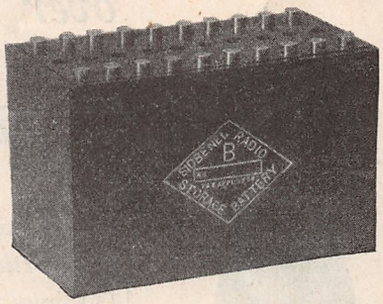
There are no "just as good" batteries. Our trade mark is on every unit.

The battery is shipped to you assembled, or partly assembled. When buying unassembled all you have to do is connect the plates together. This takes less than ten minutes. Any boy can do it. Illustrations and plain instructions with each battery. The plates are already formed and charged before shipping.

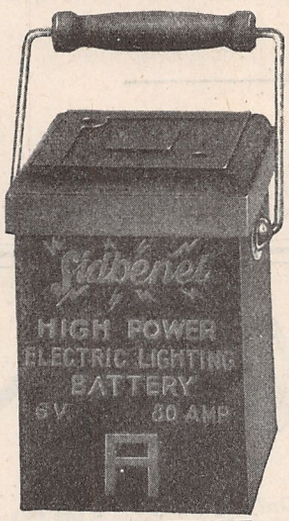
Each unit can be tapped at any desired voltage. Full capacity is 22½ volts. For higher voltage simply connect additional units in series.

One unit 22½ volts unassembled $4.25
One unit 22½ volts assembled 4.65
One unit 2 volts to supply 1½ volt tubes 40 to 60 ampere 4.65

Rectifier for A.C. sold with battery only thirty-five cents. D.C. requires none.



STANDARD *Sidbenel* RADIO "A"



Sidbenel "A" Battery will supply sufficient current for one to five vacuum tubes and a loud speaker. The container is of one piece and made of hard rubber, unbreakable, and guaranteed against breakage.

Each container has a hard rubber handle that is removable. The plates are the regular Sidbenel patented type making one of the most remarkable and best "A" Batteries ever offered. It is a six volt eighty ampere battery. The introductory price for a limited time is $14.75—with cover as illustrated $15.75.

Note:—We have increased our factory facilities in order to comply with the overwhelming demand for our batteries. We are now in a position to fill your order the very day it arrives.

FREE—Send for complete illustrated posters and complete catalog showing our list of parts and accessories that we manufacture at unheard of low prices.

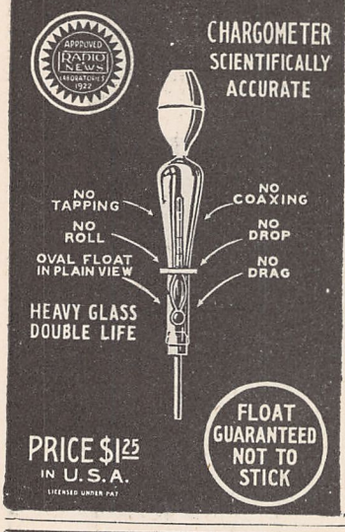
Represented by:
General Radio Co., 105 Great Portland St., London, W. I.
Jose Vallarino E Hijo, Montevido, Uraguay, S.A.
Fisher & Co., Mexico, D. F.
Antonio Flelich, S. Marco N 1235 Venezia, Italy.

Sidbenel
RADIO EQUIPMENT MFG. CO.
1663 Jerome Avenue
New York City

Compagnie Universelle de Representation et de Commerce, Ruedes Fortification 69, Anvers, Belgium.
J. Meister Sohne, Zurich 1, Switzerland.
Domingo Ortelli & Cia, Calle Corrientes 773, Buenos Aires, S. A.

SAVES YOUR BATTERY

The 'READ-EASY'



Your storage battery is the life of your Radio Set. And every time you use it there is a loss of power. The lower the charge, the faster it goes. To run the charge low damages the battery itself.

READ-EASY HYDROMETER
doubles and trebles the life of your battery by keeping a constant check on its condition. It gives

ABSOLUTELY ACCURATE READINGS
Inspect your batteries once a week with the **Read-Easy Hydrometer.** Absolutely guaranteed.

Anyone can read it.

Non drop — Never sticks
Non slop — Absolutely Accurate

Every dealer can furnish you with the READ-EASY, if he will.

Be sure to get the **Read-Easy.**. Do not accept cheap, inaccurate instruments. *At your dealer's or direct, if he will not supply you, at* $1.25 *postpaid and insured.*

Radio Division 12

ALA MFG. CO. 401-417 S. Sangamon St. CHICAGO, ILL.

The first man to listen over a telephone

didn't hear very much. Today he listens with comfort and complete understanding. The difference is due to *better apparatus.*

The AMERTRAN **super audio frequency amplifying transformer**

gives 38.6 times audibility in your receiving, *without distortion.* Two stages (2 AmerTrans) give 1490 times audibility. It is doubtful if the substitution of any one thing in a radio set could make such a notable improvement as the installation of AmerTrans.

PRICE $7
Ask your Electrical Dealer, or sent carriage charges collect (Wt. 1 lb.)

American Transformer Company

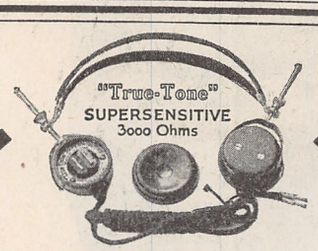
177 Emmet St. — *Designers and builders of radio transformers for over 20 years* — Newark, N. J.

卐 RADIO 卐

Complete Stock—Both Sets and Parts—All Makes

ROSE RADIO SUPPLY
129 CAMP STREET
New Orleans, La.

Send 10c for latest catalog



The Only Quality 3000-Ohm Guaranteed Head Set for $5.00

$5.00 3000 Ohms

TRUE - TONE RADIO MFG. CO.
188 No. La Salle Ave. CHICAGO, ILL.

WANTED—Back numbers of Radio News, Sept., Oct., Nov. and Dec., 1921, Jan. and Feb., 1922. Experimenter Publishing Co., 53 Park Place, New York City.

Get Into the Code Work

(*Continued on page* 1442)

assume that you are an ordinary citizen. We will relate your history in the radio game and the strong points will be easily seen, typical as they are.

You've read about wireless, but you care little about it. Pretty soon you notice that the newspapers are beginning to give a great deal more space to the new wonder of radio—the radiophone. Then one day your neighbor is seen to be climbing about the roof, stringing clothes-lines or something. It does not matter a whole lot just then, but the next night this neighbor calls you on the phone and tells you to come over; he has something that he wants to show you.

You go and when you arrive he heads straight for the attic (not the cellar). There on a table is arrayed a most uncanny lot of brilliantly shining apparatus, with lights and everything. The neighbor turns a few knobs and dials and then puts on a headset with phones a suspicious lot like those used by telephone operators. Suddenly the friend's face beams with joy, and with eyes dancing happily, he hands you the headset which you not so expertly succeed in getting placed. Then you listen, and—"What? Why, it's music!" you exclaim, and then you listen some more and you hear a voice announcing the name of the piece to be played next, and then he gives a combination of letters and tells you what station it is and where it is located.

You keep alternating and then all of a sudden you are disturbed by an interruption in the form of dots and dashes. Telling your friend, he says, "It's those darned amateurs again! They're always talking and spoiling the music." From then on you think evil thoughts of the amateurs, not because you have stopped to reason it out at all, but merely because it is an abstract instinct, bred in you since your interest in radio first evidenced itself.

Eventually your roof boasts a new-fangled clothes-line and your attic displays a radio receiving set. Your vocabulary in radio soon reaches that stage where you think you understand three hundred and sixty meters means three hundred and sixty times thirty-nine and thirty-seven hundredths inches.

Then your home newspaper starts a radio column and its editor (probably transferred from obituary writing) invites communications from the fellow who is able to hear some certain station, or something of that sort. Anyhow you send in your positively blasphemous (in hidden meaning at least) denunciation of the amateurs, and the editor's complimentary and agreeable remarks soothe your pride and make you feel that greater things must surely come your way.

Then one day you find that your set does not "percolate" properly. Your neighbor fails to remedy the ailment as do the suggestions of the question and answer department of the above mentioned radio column.

Exasperation is your lot, but it also happened that perseverance was a hidden trait, and you tried to study up on radio a little. You were fortunate enough to secure something besides a cheap money-making proposition book, and the carefully explained mysteries of radio captivated you at times; yet your continued failure to fix the set was rather vexing, to say the least.

It happens though, that you meet a regular dyed-in-the-wool "ham", one of those fellows chewing his cud over the misdirected and senseless accusations of that vast army of radiophone listeners. At your request he offers to come and see what is wrong with your set. He arrives, studies the set, asks a few questions, and in a few minutes'

The RADIOGEM

(Patents Pending)

$1 **Receiving Set—The Simplest Radio Outfit Made—Yet as Practical as the Most Expensive!** **$1**

You need know absolutely nothing about wireless to operate and enjoy the RADIOGEM. It is so sturdy, so simply constructed that it is small wonder radio *engineers who have tested* it have pronounced the RADIOGEM a brilliant achievement. The RADIOGEM is a crystal radio receiving set for everyone at a price anyone can afford.

Why The RADIOGEM Can Be Sold For Only $1

Here's the secret: The RADIOGEM Construction eliminates all unnecessary trimmings, cabinets and the like, which do not play any part in the operation of a set. You receive the RADIOGEM unassembled, together with a clearly written instruction book, which shows you how to quickly and easily construct the set, using only your hands and a scissor. The outfit comprises all the necessary wire, contact points, detector mineral, tube on which to wind the coil, etc., etc. The instruction book explains simply and completely the principles of radio and its graphic illustrations make the assembling of the RADIOGEM real fun. Remember the RADIOGEM is a proven, practical radio receiving set and will do anything the most expensive crystal set will do.

The RADIOGEM is the Prize Winner of the Age

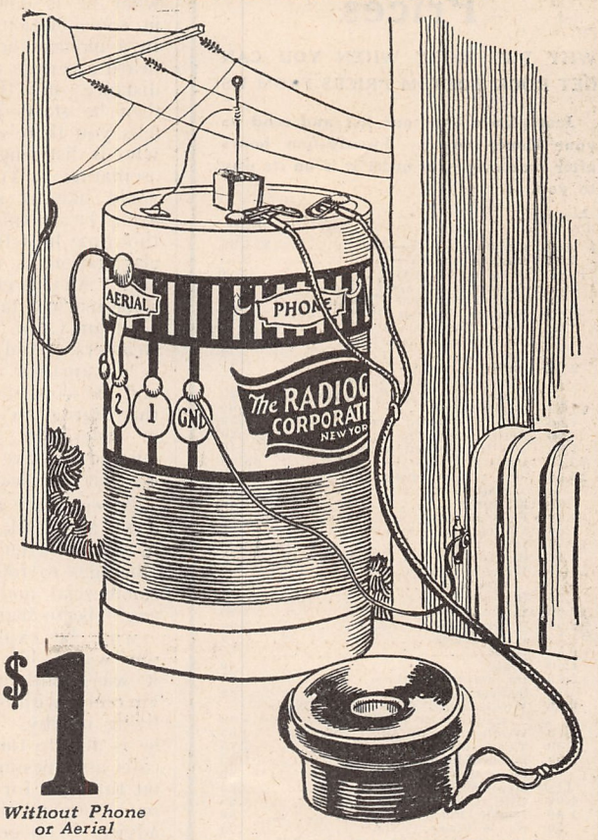
Out of hundreds of radio models submitted recently in a great nation-wide contest, radio engineers, the judges, unanimously chose the RADIOGEM as the winner—the simplest radio-receiving set made! And the RADIOGEM costs you nothing to operate; no form of local electricity is required.

DEALERS The RADIOGEM is the wonder item of the radio age. It is storming the country, for the RADIOGEM'S price is so low everyone is able to buy one. Write immediately for full particulars before that shop across the street beats you to it.

Receives up to 20 Miles

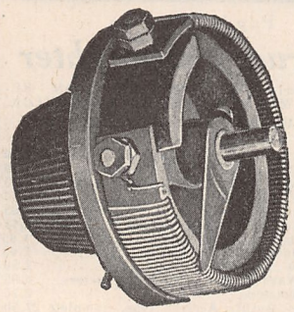
The RADIOGEM CORPORATION
42-R HUDSON STREET
NEW YORK CITY

Hear the programs of the Broadcasting Stations on the RADIOGEM



$1

Without Phone or Aerial



HIPCO

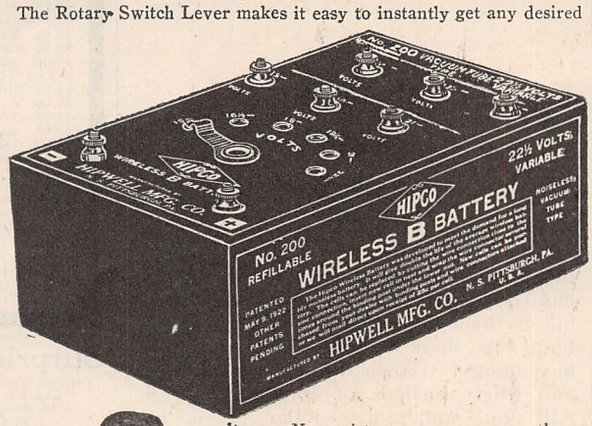
SEE THAT SWITCH

No. 200-The New Improved Hipco Wireless B Battery

The Rotary Switch Lever makes it easy to instantly get any desired voltage. No resistance to overcome, therefore, no loss of energy.

It is also Refillable and Variable same as other styles of Hipco B Batteries and is especially designed for Vacuum tube work on plate circuits and is guaranteed to be perfectly noiseless.

No. 200-22½	Volts.	Price	$3.50
No. 100-22½	Volts.	Price	3.00
No. 140-22½	Volts.	Price	2.00
No. 245-45	Volts.	Price	4.00



The Hipco Rheostat is especially designed for filament control of vacuum tubes. It operates on 4 to 6 volts. The resistance is made of a non-corrosive alloy and can be very readily renewed.

Made with several styles of knobs to match various dials.

List Price, **$1.00 each.**

Phone Condensers .001 MFD. at	35c
Phone Condensers .002 MFD. at	35c
Grid Condensers .0005 MFD. at	35c
Grid Condensers .00025 MFD. at	35c
Grid Leak Condensers .0005 MFD. at	50c
Grid Leak Condensers .00025 MFD. at	50c

For Sale at all Radio Supply Dealers

If your dealer does not have Hipco Products, write us direct. We will be glad to send our illustrated literature.

HIPWELL MFG. CO., N.S., Pittsburgh, Pa.

BUY A HIPCO MULTIPHONE

Price $4.00 Complete With Four Sets of Head Phones

Let your friends and family listen in—reproduction 100% perfect. No trouble—nothing to get out of order.

ROTARY SWITCH LEVERS

WITH SAME KNOB AS ILLUSTRATED

No. 1-1¼ Radius
List Price **50c** ea.
No. 2-1½ Radius
List Price **55c** ea.
No. 3-1 Radius
List Price **50c** ea.

We also manufacture same with knob to match Rheostat illustrated.

Compare These Prices

WHY PAY MORE WHEN YOU CAN GET ROCK BOTTOM PRICES FROM US

Just glance over our list and send us your Money Order. Twenty-four hours after receiving your order it is on its way to you.

List Price		Our Price
$ 5.00	Radiotrons U V—200	$ 4.25
6.50	Radiotrons U V—201	5.75
16.00	Baldwin Phones type C	12.00
7.75	Baldwin Units Loud Speakers	6.00
8.00	Federal 2200-Ohm Phones	6.00
8.00	Brandes Superior Phones	7.00
5.00	Acme Transformers	4.25
1.00	Double Jacks	.50
.70	Single Jac's	.50
2.50	Bull-Dog Plugs	1.25
	Contact Points, per doz.	.15
	Switch Levers 1½" radius	.25
45.00	Magnavox	38.00
1.50	100 ft. stranded Aerial Wire	.50
.50	Aerial Insulators	.20
1.00	100 ft. stranded Aerial Wire	.40
75.00	Paragon R A—10 set	68.00
25.00	90 ampere guaranteed Storage Battery	18.00
1.00	Rheostats	.75
1.00	Fada Rheostats	.75
1.00	Vacuum Tube Sockets	.65
18.50	Homchargers	15.50
3.50	B. Batteries volt meters 0-50 V.	2.75
55.00	Western Electric new style Loud Speakers	42.75
.75	Rheostats	.60
3.00	B. Batteries	2.25
2.50	B. Batteries	2.00
1.75	B. Batteries	1.10
1.50	Dials	.75
1.00	Dials	.40
2.75	De Forest Detectors	1.95
.75	Sockets	.60
6.50	Westinghouse W D—11 Tubes operated on 1 Dry Cell	5.98
1.00	Westinghouse W D—11 Sockets	.65
4.50	Thordarson Transformers	3.75
2.00	Potentiometers	1.25
½	Megohm Grid Leaks	.60
1½	Megohm Grid Leaks	.65
1.00	Grid Leak Holders	.65
1.00	Double Phone Cords	.60
.50	Single Phone Cords	.35
	Duplex Phone Adapters fits Edison, Victor or Columbia	1.75
	Genuine Bakelite Panels at 2c per square inch Spaghetti, per ft.	.09
12.00	Genuine Western Elec. Signal Corp. VT2-Tubes	9.00
112.00	De Forest type Honeycomb set, special Mahogany Cabinet	65.00
3.00	Racony Electric Light Aerial	2.00
35.00	Audimax Loud Speakers	18.50
6.50	Turney 3,000 Ohm Phones	4.25
4.50	Diamond 2,000 Ohm Phones	3.75
5.00	Fischer Variometers	3.75
6.00	Fischer Variometers	4.75
5.00	Fischer Variocouplers	3.75
6.00	Fischer Variocouplers	4.75
8.00	Atwater-Kent Variometers	7.00
8.00	Atwater-Kent Variocouplers	7.00
5.00	Pathe Variometers	3.75
14.00	Atwater-Kent Mounted Variocouplers	11.75
16.00	Atwater-Kent 2 step amplifier	13.75
8.50	Everet Head Phones, 3000 Ohms	4.95
1.50	Thordarson Rheostats	1.15
	Bus Wire for wiring sets, per ft.	.02

Honeycomb coils all sizes 20% discount.

Space being limited, we are obliged to omit many items.

WRITE FOR OUR QUOTATIONS.

Cut Rate Radio Co.

P. O. Box 472 Newark, N. J.

EISEMANN

RADIO UNITS

Made to the highest electrical and mechanical standards.

EISEMANN MAGNETO CORP'N

Chicago BROOKLYN, N. Y. Detroit

This official 14k. gold plated lapel button is now being given free to all new members of the Radio Experimenters' League. See special notice under Wireless heading in Classified Section this issue. Old members who have not yet received their lapel buttons send at once for one *free*. Tell your friends to join

RADIO EXPERIMENTERS' LEAGUE

Run by Amateurs for Amateurs

9-15 Clinton St. - - - - - Newark, N. J.

S&C RADIO LIGHTNING PROTECTOR

eliminates ground switch and gives complete protection from all High Potential currents.

SCHWEITZER & CONRAD, Inc.

4437 Ravenswood Ave. Chicago, Ill.

time has located a minor trouble, and in less time than it takes to tell it the set is working.

You are interested in his performances and wonder no little as to how he knows what he is doing. You ask him to tune in some stations and so he starts tuning. In a moment he says with joy that he has heard a certain amateur who is a good long distance off. He listens some more and then he starts grinning patiently while he tells you there's a fellow in the next block who is listening to the music with his set oscillating. You don't understand, but you'd like to, so you ask him what, and after he's explained he listens again and this time he tells you that ——, a commercial station, is in with the mush from his arc. And pretty soon he complains of some marine station which is trying to raise a steamer, or more likely half a dozen steamers. And last of all, he says there is an amateur working local off schedule and he copies down the call. To report this station to the local executive council in order that the offender might be requested to have a consideration for others, is what you learn later.

After that amateur has gone you sit down and think. Maybe the amateur is not to blame after all. He seems to have schedules to follow, and then there are the commercial and government stations—they might be to blame. And those other noises—why, he explained how a receiver sent out waves like a broadcast station when it was oscillating, and that would surely interfere with someone else who might be living nearby. And then you wonder how he is able to tune so closely and copy down calls and messages sent in code. You keep on thinking for quite a while. In a week or so you go to the amateur and get some advice. You get connected with some good textbooks and national radio magazines of repute, and in three months or so you have an assigned combination of numerals and letters, which you know as your call. Furthermore, you have an amateur's license to operate and you are enjoying listening to amateurs and talking to them much more, immeasurably more, than you ever enjoyed a phonograph concert sent by radio.

Do you get me? There's *fascination* in code work, and there's satisfaction in being an amateur, not a misled and in some cases hot-headed radiophone listener. *Get in on the code.*

Public Lemon Sale

(*Continued from page* 1486)

through sixty shocks of fodder, to be hauled by purchaser. After a honeymoon through the east, they will be at home to their friends with one good bay buggy, sixteen Rhode Island Reds and thirty bushels of corn in the crib. All sums under five dollars cash, but more time will be given the groom who is the son of one dapple gray gelding, weight 1400, age 7 years, well broke, and works any place. They have one cozy covered wagon, with three inch tires, and dump bed fitted for housekeeping on East Mulberry Street. The bride has had many beautiful parties held in her sixty bushels of onion sets and her many friends wish her much joy and three garden hose, same as new. The bride attended Ohio University and is a member of seven stands of bees.

$7.65 NOW

Don't judge a headset by its name alone, but insist upon proving its quality at the manufacturer's risk. TRIMM Professional phones are guaranteed equal to other headsets selling for $10.00 to $15.00. Positively guaranteed for one year against any defect.

Accurately matched. Perfect reproduction and articulation at any range. Designed and built by highly skilled experts of long experience.

TRIMM **PHONES**

3000 **Ohms**

Was $10.00

One-piece magnet, formed (not punched), guaranteed uniform tempering and magnetizing. Cases and caps made entirely of high grade Phenol compound, free from sulphur and corrosive gases; odorless and warpproof. New type head band insures perfect comfort.

Free Trial If you do not find the TRIMM Professional superior to any $10.00 headset return it and your money will be refunded.

DEALERS: Our wholesale and retail distributors are fully protected. Write for quantity discounts and full particulars. We ship your first order on approval.

TRIMM RADIO MFG. CO.

DEPT. 34 24-31 S. CLINTON ST., CHICAGO

Pay No Express

February Slaughter

SENT POSTPAID ANYWHERE UPON RECEIPT OF MONEY ORDER, CASH OR CHECK.

STORAGE BATTERIES VIA EXPRESS COLLECT.

$5.00 Detector Tubes, guaranteed	$ 3.00
$6.50 Amplifier Tubes, guaranteed	3.50
$6.50—1½-volt Tubes, Extra Long Life	5.25
$6.50 W. D. 11 Tubes	5.75
$8.00 Everett Phones	5.25
$8.00 Dreyfus or Federal Phones	6.15
$3.75—23-plate variable Condensers	1.95
$4.75—43-plate variable Condensers	2.65
$5.00 Vario Couplers	2.50
$9.00 All Wave Couplers, to 3,000 meters	6.95
$5.00 Variometers	2.75
$65.00 Tube Outfit, Aeriola type, complete	27.50
$1.00 Rheostats	.60
$1.00 V. T. Sockets	.60
$1.00—3-inch Hard Rubber Dials	.45
$3.00 Racony Antenna Plugs	1.50
$4.50 Thordarson Transformers	3.65
$3.50 Double Slide Tuning Coils	1.95
$1.75—22½ V Cyclone var. B Battery	1.10
$4.00—45 V Cyclone var. B Battery	2.75
35c Galena Pyrites Grid or Phone Condensers	.15
6-volt Guaranteed U. S. Storage Batteries	$7.50 up

PRICE LIST FREE

Broadway Electric Novelty House

134 Third Avenue, New York

Surprise Offer

Vermica Variable Condenser Capacity .0005 MF Large production permits this price

$1.48

Postpaid

Newest Style Condenser. Sharp Tuning — Close Adjustment. Endorsed by leading Radio authorities.

If your dealer can't supply WRITE TODAY. Send check, Money Order. Satisfaction Guaranteed or Money Refunded.

C. S. CHERPECK CO., 3127 Davlin Court, Chicago

ENGRAVING MACHINES

For

RADIO PANELS

And Other Radio Engraving

ENGRAVERS & PRINTERS MACHINERY CO

Sag Harbor, New York

MAKE THIS A RADIO YEAR

DX Type No. 58 R. F. RECEIVER

GREAT
SELECTIVITY
AND
EXCEPTIONALLY LONG RANGE
ARE SOME OF THE
CHARACTERISTICS
OF THE

Federal

DX TYPE NO. 58 R. F. RECEIVER

Unquestionably the most Sensitive Radio Instrument on the market

IF YOU DON'T LIKE THE PROGRAM YOU ARE LISTENING TO
YOU MAY FIND ANOTHER MORE SUITABLE TO YOUR TASTE

For Detailed Description Write for Bulletin No. 119-W

Federal Telephone & Telegraph Co.

MANUFACTURERS OF STANDARD RADIO APPARATUS

BUFFALO, N. Y.

RADIO MERCHANDISE

F. D. PITTS COMPANY

(Incorporated.)

219 COLUMBUS AVE., BOSTON, MASS., U. S. A.

Wholesale Only

Distributors for

A. H. Grebe and Co.
Acme Apparatus Co.
Adams Morgan Co.
American Eveready Works
American Radio and Research Corp.
Atwater Kent Mfg. Co.
Baldwin, Nathaniel Co.
Burgess Battery Co.
Chelsea Radio Co.
Clapp-Eastham Co.
De Forest Tel. and Tel. Co.
Dubilier Condenser Co.
Electrose Mfg. Co.
Fada.
Fahnestock Elec. Co.
Federal Tel. and Tel. Co.
France Mfg. Co.
Frost, Herbert H. and Co
General Radio Co.
Jewell Elec. Inst. Co.
Magnavox Co.
Mitchell, R. and Co.
Murad Laboratories
Murdock, Wm. J. Co.
Pacent Elec. Co.
Radio Corp. of America
Remler Radio Mfg. Co
Signal Elec. Mfg. Co.
Western Elec. Co.
Weston Elec. Inst. Co.
Wireless Press

PITTSCO

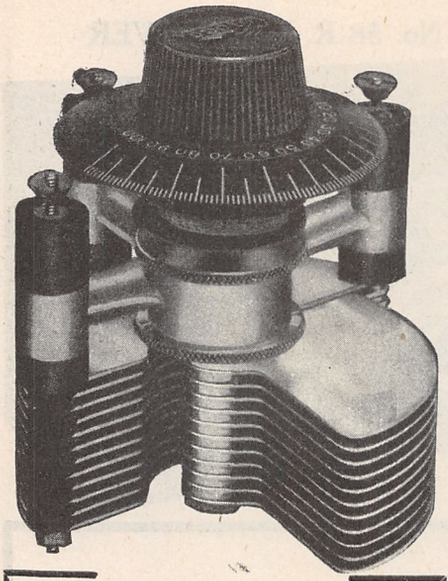
"GREBE RADIO"

Grebe CR-3 Receiver, 150-1000 meters	$65.00
Grebe CR-5 Receiver and Vacuum-tube Unit, 150-3000 meters	80.00
Grebe CR-8 Receiver and Vacuum-tube Unit, 150-1000 meters	80.00
Grebe CR-9 Receiver, Detector and Two-stage Amplifier, 150-3000 meters	130.00
Grebe CR-10 Radiotone Concert Receiver, Detector and Three-stage Amplifier, Victrola type	315.00
Grebe RORK Two-stage Amplifier	55.00
Grebe RORD Detector and Two-stage Amplifier	75.00

Grebe RORN Tuned Radio Frequency Amplifier. "Without going out of doors," said Lao-Tzu, "one may know the whole world." "Let a GREBE RECEIVER bring the whole world to your evening fireside."

DEALERS—Attractive discounts and immediate deliveries from stock! Send for Our Latest Price List, No. 3.

"F.D. PITTS CO. NEW ENGLAND DISTRIBUTORS OF GREBE RADIO"



Cotoco

TRADE MARK REG. U. S. PAT. OFF.

The Variable Air Condenser that Gets the Best from your Set

Thousands of good sets are giving their owners pitiful results for only one reason, namely inefficient Variable Air Condensers. Did you buy a cheap condenser? Not cheap in price perhaps, but cheaply made; a condenser in looks but not in action. Go to your dealer and ask to see this one. It is as efficient as it is clean cut in appearance. Take it home. Try it. You'll be rewarded.

Insist Upon COTOCO PRODUCTS

Amplifying Transformers for
Audio Frequency
Radio Frequency
Sockets—Dials
Cotocoils—The Original
Concentrated Inductances

If your Dealer Fails you Write us Direct.

Accept no substitutes. You can't afford to. Ask for Cotoco Quality and get it if you have to write us.

COTO-COIL CO.
87 Willard Ave.,
PROVIDENCE, R. I.

UNIVERSAL RADIO & RESEARCH Co

199 So. Fair Oaks Ave.
PASADENA CALIFORNIA

DENVER

9ZAF REYNOLDS RADIO CO. KLZ

1534 Glenarm St.
LARGE RADIO DISTRIBUTORS

Linking the World's Farms by Radio

(*Continued from page* 1443)

working out a system of flashing international crop advices around the world. The international radio market news service, the new arrangement is called.

The service was inaugurated November 4 upon the receipt by radio by the Department of a report of the size of the German beet sugar crop from the Departments representative at Berlin. The message stated that beet sugar production in Germany was estimated at 1,839,000 short tons from a harvest of 10,890,000 short tons. Taken in conjunction with figures on the Cuban crop the information was of vital importance to cane sugar growers in Louisiana, to beet sugar growers in California, and to the sugar trade generally. The information was immediately dispatched to branch offices of the Department of Agriculture over its leased telegraph wire system, thence relayed by radio throughout the land.

"Traveling with the speed of light—186,000 miles a second—the news was in the hands of receiving operators all over the country in less than five minutes from the time the message left Berlin," a Department report states.

For a long time it has been the view of leading economists that American farmers should know more about world agriculture. Inasmuch as prices of staple crops are controlled in world markets as determined by world supply and world demand, the American farmer is concerned not only with the size of crops in his own country, but with the quantities produced abroad. Heretofore he has been unable to obtain such information because of lack of methods of broadcasting crop news throughout the world simultaneously to large numbers of people. The use of radio overcomes this handicap, and is expected to go far in coordinating the world food supply with the demand—a fundamental prerequisite in solving the farmer's problem of what and how much food to produce, and in placing the world food situation on a stable basis.

Almost any day of the year thirty to eighty million bushels of wheat are afloat enroute to world markets. This large floating supply has great potential influence in keeping price levels on a steady basis, for when any wheat port on the Atlantic, the Baltic Sea or the Mediterranean gets out of line three or four cents a bushel, within twenty-four hours or less cargoes are frequently diverted to that port by wireless. Thus radio has already played a large part in world agricultural trade, making possible the stabilization of prices and preventing the violent price fluctuations which have proved so disastrous to agriculture in the past. According to E. G. Montgomery of the United States Department of Commerce, the progress made during the past century in the methods of communication, transportation and food preservation have made possible the exchange of commodities between producer and consumer thousands of miles removed from each other. The international exchange of crop news is regarded as an important additional step in opening new world markets for American products.

The Department of Agriculture is planning to develop its international radio service to the highest possible degree of efficiency. It is enabled to do this by reason of the nation-wide radio market news service that has been perfected in the United States for broadcasting weather, crop and market reports. The Department has several agricultural representatives located in foreign countries and these men have been

INTRODUCING
DELFELCO
RADIO B BATTERIES

THEY ARE
Dependable
Extra Heavy
Longer Life
Fully Guaranteed
Easily Connected
Larger Cells
Connections Positive
Once Tried Always Used

DISTRIBUTORS WANTED
DEALERS and JOBBERS
WRITE FOR OUR PROPOSITION

Delfelco Battery Corporation
Pawtucket, R. I., U. S. A.
General Office 12 Meeting Street
Factory 28 Bayley Street

CET AN F.R.S.
Long Distance Single Bulb RECEIVER
$17.50

RESPONDS to wave lengths up to 600 meters. All molded Panels, Dials and Sockets. Has Variocoupler and "Read 'Em" Binding Posts, Rheostat and Rotary Switch, complete. Fine Mahogany Cabinet with Phone Compartment. May be hooked up in any standard circuit. **Pin a Money Order to this ad,** mail it today and you will be all set to enjoy the wonderful programs broadcasted every day.

FOR $40

we will send you the F. R. S. Complete Two-Stage Long Range Receiver, including Cabinet — ready to hook up. A $125 value!
Batteries, Tubes and Phones extra

F. R. S. RADIO CORPORATION
409 E. E. Fort St., Detroit, Mich.

RADIO SCHOOL
Positions Guaranteed Graduates
Send for Catalog
MASSACHUSETTS RADIO & TELEGRAPH SCHOOLS Inc.
18 Boylston St. Boston, Mass.
G. R. ENTWISTLE, *Radio Director*

RHAMSTINE*
Quality Amplifying Cabinets, R.F. and A.F. Transformers, Rheostats, Potentiometers, etc., at moderate prices. Catalog on request.
J. THOS. RHAMSTINE*
Maker of Radio Products
2152 East Larned St. Detroit, Mich.

CONCERTS FROM 14 CITIES

in one evening with new Fedder's Model J. R. H. Receiving Set

ONE Radio Expert called the new J. R. H. Model the "ears to a nation." It is wonderful to think that all the family can enjoy concerts from near or afar. Undoubtedly, the Socostat plays a great part in the efficiency of the J. R. H. Set. It consists of six tubes—detector, two steps of Audio and three of Radio Frequency, tuning directly on an inside loop.

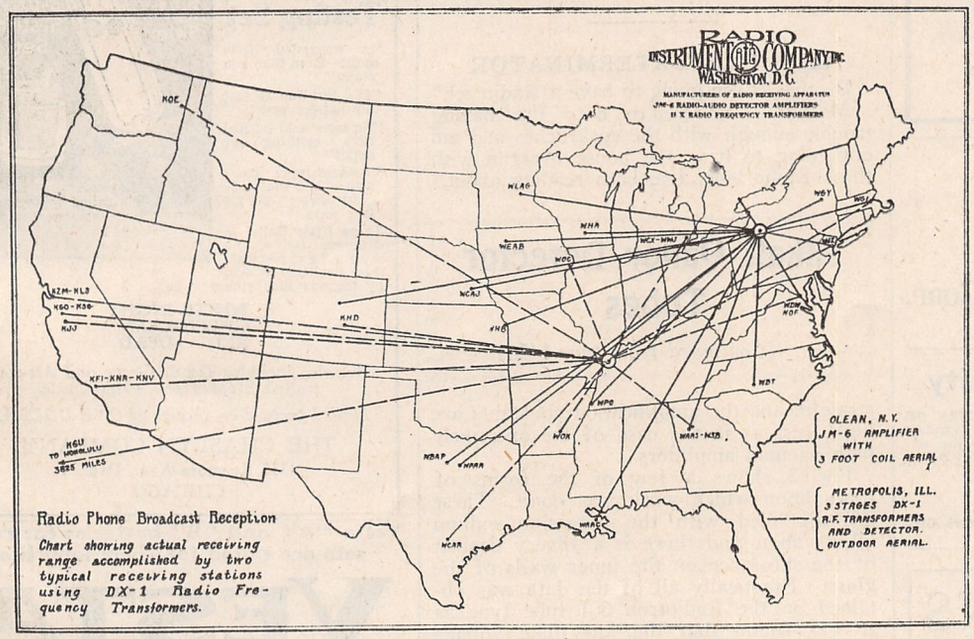
Below is an average concert heard each evening with a J. R. H. set at Buffalo, N. Y. On Thursday, October 19, 1922, the concert consisted of:

Time	Station	City
4:55	CFCA	Toronto
6:40	WOR	Newark
7:15	WGY	Schenectady
7:30	WGR	Buffalo
8:00	WMAK	Lockport
8:30	WOO	Philadelphia
8:42	CFCA	Toronto
8:50	WBZ	Springfield
9:15	KDKA	Pittsburgh
9:30	WGY	Schenectady
9:45	WEAN	New York City
10:00	WHB	Kansas City
10:30	WGI	Boston
11:02	WIP	Philadelphia
11:15	WDAT	Chicago
11:20	CJCG	Manitoba Free Press
11:45	WSB	Atlanta
12:00	WDAT	Chicago
12:40	WDAT	Chicago
12:40	WSB	Atlanta
1:00 a.m.	WSB	Atlanta

And all stations came in as "clear as a bell.' By means of the Socostat, practically all tube noises were eliminated. A New York Radio Dealer said after hearing a concert, "The new Fedders J. R. H. Model is the most efficient set I ever heard.

ASK FOR A DEMONSTRATION

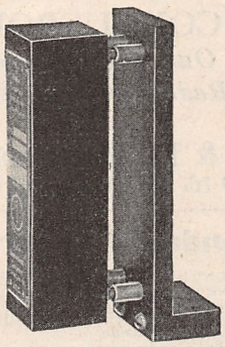
FEDDERS MANUFACTURING CO., 55 Tonawanda Street, BUFFALO, N. Y.



Radio Phone Broadcast Reception

Chart showing actual receiving range accomplished by two typical receiving stations using DX-1 Radio Frequency Transformers.

DX-RADIO FREQUENCY TRANSFORMER



Patented Dec. 19, 1922

First on the Market Best by Test

It Pays to Have the Best

Dealers Write for Literature

RADIO INSTRUMENT COMPANY, INC.

TRADE MARK REG.

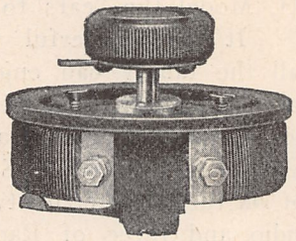
WASHINGTON, D. C.

HUTCHINS BLDG., 10TH AND D STS., N. W.

If your dealer does not have DX Radio Frequency Transformers, write us.

	Wave-Length Range	Price
DX-1	170- 450	$8.00
DX-S	400-1200	8.00
DX-2	900-3000	8.00

CLICKERTY CLANK



Does your rheostat go—"Clickerty-clank! BANG!" whenever you make an adjustment? It would not if it were General Radio constructed. When your tube is approaching the critical point, it is necessary that the adjustment be fine and introduce no extraneous noises in your head phones.

When you construct your set, you would not mount a toaster on the panel. Then why mount a rheostat that runs hot? The radiation surface of the General Radio rheostat is sufficient to permit the rheostat to be mounted in small enclosed spaces without fear of heat damage.

The base is real bakelite—no substitutes used. The switch blade is rugged phosphor bronze and polished nickel plated. The knob is convenient and attractive.

Made in two styles, Type 214-A for back-of-panel mounting, and Type 214-B for front-of-panel mounting or portable use. Also made in two sizes, for receiving tube and for power tubes.

7 ohms, 1.5 amps. for receiving tubes
2 oms. 2.5 amps. for receiving tubes
PRICE, any style.....$2.25

Similar in general dimensions and design to the rheostat is the 400-ohm potentiometer. This instrument is ideal for grid biasing.

PRICE, any style.....$3.00
Send for Free Radio Bulletin 912-T

GENERAL RADIO COMPANY
Massachusetts Ave. and Windsor Street
CAMBRIDGE 39, MASSACHUSETTS

Do not confuse the products of the GENERAL RADIO CO with those of other concerns using the words "General Radio." The General Radio Co. has been manufacturing radio and scientific instruments for many years. It has no affiliation with any other company.

Standardize on General Radio Equipment Throughout

CONQUEROR
One Knob Control
Radio Receiving Set

Write
LEWIS & DEROY RADIO CORP.
560 7th Ave., New York City

A Wonderful Opportunity

The Eastern Division of THE RADIO CORPORATION OF AMERICA accept no applicants in their services as Wireless Operators other than our Graduates. Investigate the advantages offered through taking either our HOME STUDY or RESIDENCE course in Radio.

RADIO INSTITUTE OF AMERICA
(Formerly Marconi Institute)
324 Broadway New York City

REAL RADIO **BARGAINS**

RADIO SUPPLIES at lowest prices.
WRITE TODAY. Send 2c stamp for catalog.
Our Standard
QUALITY — LOW PRICE — PROMPT SHIPMENT
APEX RADIO CO. 6914 S. Halstead St. CHICAGO, ILL.

WESTWYRE VARIABLE CONDENSER

THE WESTWYRE RADIO COMPANY
Westfield, Mass., U. S. A.

instructed to use radio in dispatching important agricultural news to Washington. At Washington it is planned to turn over these messages to government telegraph and radio operators for broadcasting throughout the United States. The sixty or more public and private radio stations in all sections of the country that now broadcast domestic agricultural news will pick up the world reports and relay them over agricultural districts.

Another feature of the service is the gathering and broadcasting of news of American crops to other countries, thereby establishing a complete world system of exchanging crop reports. This phase of the work has been in operation since last May in accordance with an interdepartmental arrangement whereby naval radio stations throughout the world are used in the transaction of government business. Once a week reports on the condition of the American cotton crop and of wheat seeding in the United States are dispatched to the International Institute of Agriculture at Rome. In turn the Institute keeps the United States government informed of crop conditions abroad, and the news is immediately flashed throughout the United States by radio. The naval radio stations are used without cost by United States government departments, and only a nominal charge is made when foreign-owned stations are used, ranging from two cents a word in the case of a station in the Netherlands to thirty-six cents a word for messages received or filed at Labasa in the Fiji Islands. More than 100 radio stations outside the United States, some of them located in remote corners of the world, are entered in the international arrangement.

With the use of radio the wheat, corn, cotton and live stock growers in America wherever they are located can now figuratively look into every nook and corner of the earth and see the growing crops with which they must compete in world trade.

GET THE EXTERMINATOR

Brother: "I'm going to have a Radio set."
Mother: "No you're not; I'm having trouble enough with the cockroches and am not going to have the house overrun with those Radio bugs I've been reading about."

Alkali Vapor Detector Tubes

(*Continued from page* 1456)

straight, and the amplification constants are high, just as in the case of the extremely high vacuum amplifiers.

Fig. 2 shows a few of the forms of tubes upon which work was done. These are all filled with the potassium-sodium alloy vapor, and there is a silvery deposit of the substance on the inner walls of the glass. Practically all of the data was obtained on the Radiotron 201 tube type as it was found that the low plate voltage characteristics are only obtained for close spacing of the electrodes. Fig. 3 shows the apparatus used in pumping out and filling the tubes. A vacuum tube is shown in position ready for filling. Two high speed, high efficiency vacuum pumps are shown on the masonry pier. The supply of potassium sodium alloy in a liquid form similar to mercury is contained in the bulb B. This material must be prepared and handled only in a high vacuum. When the vacuum is sufficiently high about .00005 mm. the bulb B is tipped up so that a little of the alloy runs down into the large stem fused onto the tube where it is carefully heated until enough distills over into the vacuum tube

MICON TESTED MICA CONDENSERS

Assure—

Absolute noiselessness
Clarity of tone
Accuracy
Constant fixed capacity

Size	Price
.00025	$0.35
.0005	.35
.001	.40
.002	.40
.0025	.50
.005	.75
.01	1.50

Micon Condensers are especially adapted for use with Radio - Frequency, Super - Regenerative and other circuits, where an accurate fixed condenser is required.

For protection against damage to the filament and the consequential short life of filaments, Micon Condensers are invaluable.

At your dealers—otherwise send purchase price and the desired Micons will be sent without further charge.

Chas. Freshman Company, Inc.
97 Beckman Street New York City

Everybody Tickled
With the CHASLYN Sink -or- Swim Ball Battery Testing Set

"A wonderful little outfit—more than you claim"
"It's just fun to test my battery now"
"No more acid-burned rugs, clothing or hands"
"Astonishingly accurate — has the scale hydrometer beat four ways."

Three little Balls, of different colors and weights, instantly show condition of acid by the way they sink or swim.

WHITE-RIGHT
GREEN-LEAN
RED -DEAD

Set also includes Depth Gauge and Air-controlled Stopper for water bottle.

Mailed prepaid on receipt of ONE DOLLAR

THE CHASLYN COMPANY
4315 Kenmore Ave., Dept. 1
CHICAGO

Vesta "A" and "B" batteries for radio sets are noted for their long life.

VESTA

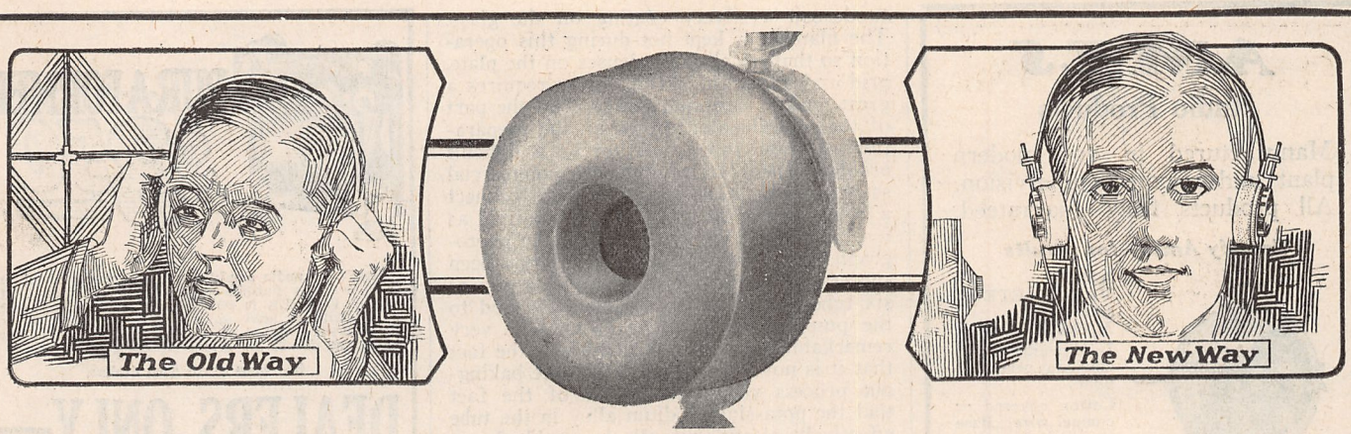
COSTS LESS PER MONTH OF SERVICE

RADIO DEALERS WRITE

for our free booklet "How to Sell Radio Over the Counter." Full of selling ginger and common sense. Covers every point. Mailed promptly.

LEFAX, INC.
940 Sansom St., Philadelphia

Be a Radio Agent. $50.00 starts you. We are manufacturers. Write for details. State Territory desired. Picard Radio Corp., Dept. G. 16 W. 46th St., New York.



Ear Comfort, at Last, for Radio Fans

That's What the New Bates Ear Cushion Ensures

What it is: A very light, soft, soundproof cushion which fits over the radio receiver, excluding *all* outside noise yet permitting the free transmission of every whisper of sound from the instrument in full volume and true tone. Its greatest advantage over the old style is the wonderful *comfort* it affords—can be held in place against the ear for hours without discomfort.

How Constructed: A smooth, soft pure gum rubber cover enclosing a springy pad of *cushioned* rubber. Slips easily over any ordinary receiver and fits snugly into the crevices of the ear. Light as a feather—which adds greatly to the comfort of the user. An ample orifice permits the passage of tones from the radio in full volume.

Obtain these from your dealer if possible. If you cannot, mail attached coupon and $1.50 and we will send postpaid "One Set Bates Ear Cushions" for the Radio.

My name is .....

..... Town.....

State.....R. F. D.....

My dealer's name is .....

Town.....State.....R.F.D.....

Controlled and manufactured exclusively by

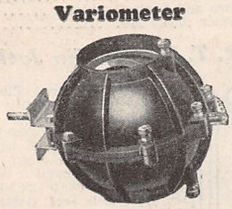
BATES & COMPANY

1520 Montana Street
CHICAGO ILL.

Kellogg Radio Equipment for Better Results

Easy to Mount—Simple to Operate

Variometer



All Bakelite moulded variometer. Two rotor and three stator terminals. Standard wound. For panel or base mounting.
No. 501.....Each $8.00

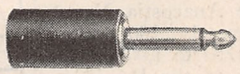
Dial

Four-inch, all Bakelite. Non-warping, reinforced construction.
No. 502.....Each $1.25

Microphone

Standard Microphone. Supersensitive. The result of twenty-five years experience.
No. 21.....Each $8.90

Plug



The Kellogg plug fits all jacks. It is of strong construction and handsomely finished.
No. 501.....Each $1.00

Head Set

The value of extremely light and very small head sets in Radio receiving is most evident when using Kellogg head receivers, which, however, have proved as sensitive and thoroughly efficient as they are light in weight and small in size.

Jack

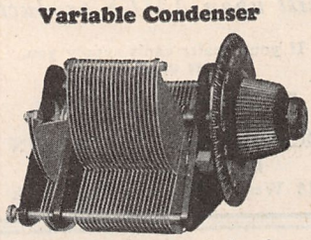
Positive contacts, constant spring tension. Durable insulated frame.

No.		Each
501	4 Conductor...	$1.10
502	2 Conductor...	.75
503	3 Conductor...	.80
504	4 Conductor...	1.10
505	6 Conductor...	1.25

No. 69A

No. 69A Head Set, 2400 ohms.....Each $10.00
No. 69C Head Set, 2000 ohms.....Each $8.00
No. 74A Head Set, 1000 ohms (Single). Each $5.00

Variable Condenser



This condenser is of the decremeter type and is unusually well constructed.

No. 601 11 plate with 5 plate Vernier. Knob and 4-inch Dial. Each.....$6.75
No. 602 11 plate without Vernier. Less Knob and Dial. Each.....$4.50
No. 603 23 plate with 5 plate Vernier. Knob and 4-inch Dial. Each.....$7.75
No. 604 23 plate without Vernier. Less Knob and Dial. Each.....$5.50
No. 605 43 plate with 5 plate Vernier. Knob and 4-inch Dial. Each.....$8.75
No. 606 43 plate without Vernier. Less Knob and Dial. Each.....$6.50

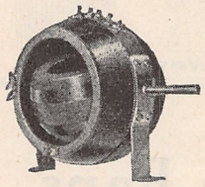
KELLOGG SWITCHBOARD & SUPPLY CO., CHICAGO

AMES

Radio Products

Manufactured in our modern plant under expert supervision. All products fully guaranteed.

Specify Ames—for results



AMES VARIOMETER and VARICOUPLER

In appearance and efficiency second to none.

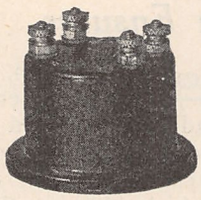
Cotton covered or enamel wire. Base or panel mount.

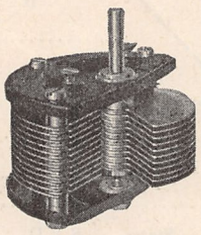
Prices—
Variocoupler $6.00
Variometer 6.50

AMES AUDIO FREQUENCY TRANSFORMER

Designed especially to eliminate distortion, for the reception of speech and music. Completely encased in nonmagnetic metal for shielding. Ratio 4½ to 1.

Price $5.00





AMES VARIABLE CONDENSER

Accurately spaced plates and rigid construction eliminate "shorts" and unequal variations of capacity. Insulation is genuine Micarta. Patented top and base.

Prices
11 plate $2.00
23 plate 2.50
43 plate 3.00

GENUINE PICARDITE DIALS

Exclusive Interchangeable bushings, fits 3/16" or 1/4" shafts perfectly.

Prices
2½" 50c.
3" 60c.
4" 75c.
Extra bushings 5c. ea.

Insist upon AMES products.

If your dealer can't supply you, write us direct.

Special Proposition to Dealers.

PICARD RADIO CORPORATION
Wholesale Distributors
18 West 46th Street, New York

For Sale

2 Belden Winding Machines, with speed regulation for winding small magnets. These machines are particularly useful for winding telephone receiver magnets and for similar work. Box No. 56, RADIO NEWS.

to deposit a silvery coating on the glass. The filament is kept hot during this operation so that no alloy condenses on the plate, grid or leads. The manipulation requires a great deal of care and patience on the part of the experimenter; however, the preparation of these tubes will not be a difficult problem when carried out on a commercial scale, because it is just as easy to connect a large number of tubes on the manifold as it is to prepare the one shown in the photograph. The preparation process has been successfully accomplished with as many as six tubes connected to the manifold and to the pumping apparatus shown. One very remarkable and desirable feature is the fact that it is not necessary to carry the baking-out process very far because of the fact that the potassium sodium alloy in the tube effectively cleans out all the residual gas by chemical action after the tube has been standing for a week.

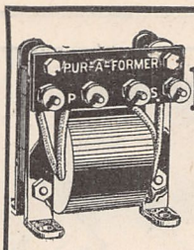
The low voltage characteristics hold only for tubes with close spacing of the electrodes. It will interest the amateurs to know that several of the dry cell type of detector tubes were prepared in this manner, and these tubes function almost as efficiently as the standard storage battery operated type; and with one dry cell supplying the filament current, and plate voltage obtained by connecting the plate circuit return to the positive filament lead. This arrangement eliminates both the expensive A and B batteries. It is sincerely hoped by the writers that these vacuum tubes will be available for the public, and it is believed that the cost of manufacture will not materially exceed that of the conventional type now in use. Further research work is now in progress to determine the effect of variable spacing of electrodes on the efficiency and characteristics of these tubes.

Broadcasting First Presidential Message to Congress

(*Continued from page* 1441)

the rostrum on which President Harding stood, received the voice vibrations. From this cup-like device, the sound waves were conveyed by a telephone wire to the Naval Air Station, at Anacostia, D. C., approximately four miles away. Here, the United States Navy Department maintains a powerful radio-telephone transmitting outfit, the one in service at Schenectady, N. Y., under the direction of the General Electric Company, alone exceeding its range as a radio-telephone sending station.

The message of the Chief Executive of the Nation, having been relayed to Anacostia along a telephone line built by the Chesapeake and Potomac Telephone Company, was broadcast on 427 meters. The daylight effective range of the radio-telephone transmitter at the Anacostia Naval Air Station is approximately 200 miles, compared to a radius of 750 to 1,000 miles at night. The utterances of the President borne on the medium of electro-magnetic waves, transmitted from Anacostia, were received by newspapers and other radio-telephone stations in the east, west, south, and north and re-broadcasted to another invisible audience. The Pittsburgh Post, Chicago News, Indianapolis News, St. Louis Post-Dispatch, Kansas City Star, and Denver Post covered the Western half of the country as with a blanket. Northward, wireless stations in Philadelphia, Newark, and the American Telegraph and Telephone Company in New York disseminated the words of President Harding. In the south, the Louisville Courier-Journal and Times, and other newspapers maintaining wireless receiving and sending apparatus, "picked up" the message on 427 meters from the Naval Air Station and re-broadcast it to



PUR-A-FORMER $3.50

Here's an audio amplifying transformer without any frills or fancy finishes—just solid honest value. The PUR-A-FORMER is compact and strongly built—amplifies without howl or distortion. Takes minimum space in your set and will produce results equal to many selling at double the price. Winding ratio 4½ to 1.

Buy them at all good dealers.

DEALERS ONLY—

Write for Harry Alter's RADIO "POCKETBOOK."

A net price catalog of radio supplies published each month. Our wholesale prices hit bottom.

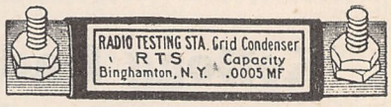
The RADIO "POCKETBOOK" sent free to dealers only. Use your letterhead.

HARRY ALTER & CO.
We Sell Wholesale Only
126 N. May St. Chicago

RTS *Big Profits in R. T. S. Equipment*

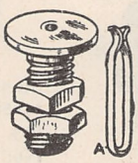
R. T. S. Equipment converts the onetime buyer into a profitable, permanent customer. By handling R. T. S. Standard and Special Equipment you can fill every demand promptly with satisfaction to your customer and profit to yourself.

The R. T. S. Condenser, shown here, is proving unusually popular. They make the tubes perform properly, cut out "howling" and clear up phone speech. Furnished complete with mountings, ready for connection.



Made in three capacities, priced to retail as follows:
Grid Condenser .0005 MF. .....30c each
Grid Condenser and Leak Combined .....45c each
Phone Condenser .0013 MF. .....30c each

R. T. S. Cord Tip Jack



This R. T. S. Cord Tip Jack leads the way in price, quality and service. "A" shows inside of jack. Constructed of spring phosphor bronze, highly nickeled. A wiping spring contact insures a clean positive contact at all times. Where others sell from $1.00 to $2.50, the R. T. S. Cord Tip Jack Retails at, per pair **50c**

Jobbers and Dealers — Send TODAY for NEW Wholesale Catalog, prices and scale of discounts to recognized trade.

RADIO TESTING STATION
25 Sturges St. Dept. R-2 Binghamton, N. Y.

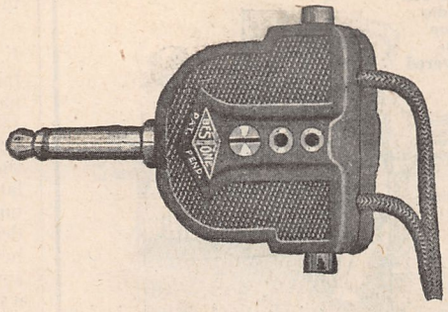
TIMES APPLIANCE CO., INC.
145 WEST 45th STREET, NEW YORK
WHOLESALE ONLY
Radio Parts, Sets and Equipment of All Kinds
Send for Our Price Schedule. Will Ship to Any Part of the U. S. and Canada

GREEN SEAL
AIR-WAY RADIO Equipment appeals to the discriminating user for its genuine quality at fair prices. Write for Free Air-Way Bulletin of Complete Sets and Standard Parts. Attractive dealer proposition.
Air-Way Electric Appliance Corporation, Toledo, Ohio.

RADISCO RADIO PRODUCTS
THE RADIO DISTRIBUTING COMPANY
Newark, New Jersey

New! Better!
BESTONE RADIO PRODUCTS

WIRELESS BESTONE TRADE MARK APPARATUS



Are you satisfied with mere "noise" and distorted "sounds" from your Receiving Set? It's all in the QUALITY of the apparatus used.

Bestone Wireless Apparatus are noted for scientific accuracy, clarity of tone and unusual volume. The Bestone products illustrated are without equal in design, construction and actual RESULTS.

We manufacture a wide range of Crystal and Vacuum Tube Receiving Sets as well as a complete line of radio parts.

If your dealer cannot supply you, communicate with us direct.

Send for Illustrated Catalog "N".

HENRY HYMAN & CO. Inc.

Manufacturers

Executive Offices:
476 Broadway, New York

Branch:
212 W. Austin Ave., Chicago

BESTONE "SPRING GRIP" TELEPHONE PLUG

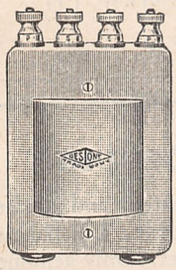
No. 727

New design—new construction—new features. The Plug that requires no disassembling. Just press the buttons—the cord tips cannot loosen. No more fussing or mussing with tools. You do not have to take the Plug apart for any reason whatever. Saves time, temper, and assures better results. Provides connection for three Head Phones. List price.....$1.25

BESTONE CONDENSITE VARIOMETER $6.50

No. 710

Similar in construction to Bestone condensite vario-coupler.



BESTONE AMPLIFYING TRANSFORMER

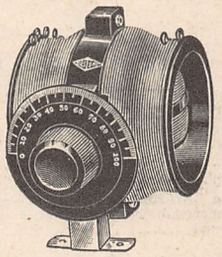
No. 715

Without doubt this apparatus is the foremost type of its kind. Assures clarity and volume of tone as well as undistorted reception. This Bestone product is characterized by superiority of design, excellence of materials and scientific construction. Spaghetti tubing insulates all internal wiring. Is fully enclosed in handsome aluminum case. List price....$5.00

BESTONE CONDENSITE VARIO-COUPLER

No. 712

The most improved vario-coupler on the market. Unequalled for appearance, and results. Is constructed of genuine condensite, mahogany colored. By its unique design the primary and secondray coils take the same general outline within each other placing them in very close proximity. Primary divided into 16 taps enables very close tuning. Equipped with 3" Bakelite dial. Wave-length 150-800 meters. List price.....$7.50

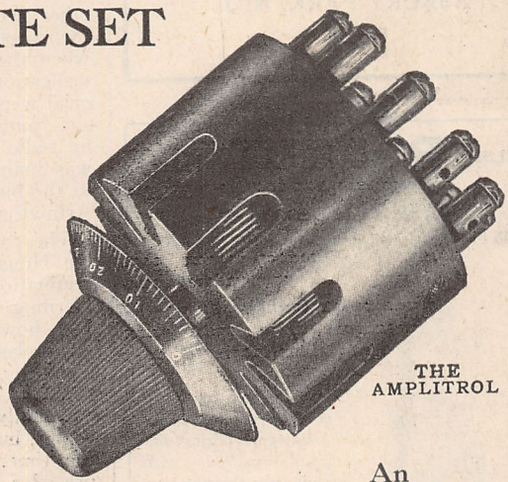


MAKE YOURS AN UP-TO-DATE SET

Now for the first time you can have complete control and adjustment of each amplifier tube merely by turning a simple knob. Do away with all jacks, plugs, rheostats and switches. The knob of the Amplitrol switches on the plate circuit and adjusts the filament circuit at the same time. Turn on any stage of amplification at will.

The Amplitrol lengthens the life of the tube from one-third to one-half, as it absolutely prevents throwing a heavy current suddenly onto the delicate filament. With the Amplitrol in use, the current is turned on *gradually*.

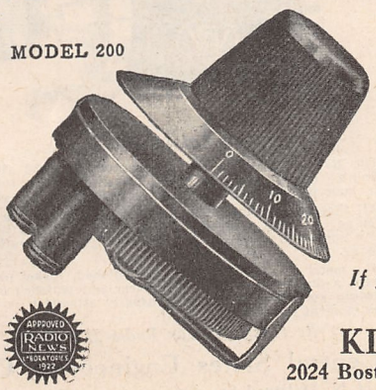
Genuine condensite, white graduations on black dial, phosphor bronze contacts. Highest grade. Complete with simple wiring instructions, $4.00.



THE AMPLITROL

KLOSNER

MODEL 200



Only a rheostat with a vernier can make your set more sensitive. It is impossible to tune out interference without perfect adjustment of your detector tube. No ordinary rheostat can give you the fine adjustment necessary for perfect reception.

The Klosner Vernier Rheostat has a micrometer adjustment that permits getting exactly on the right spot for perfect radio reception.

The Klosner Rheostat operates both coarse and fine adjustments with one knob—an exclusive feature protected by broad patent claims. It is wire wound like all true electrical instruments. It has a graduated dial to show just where it is set. No guessing.

Condensite, phosphor bronze contacts, white graduations on black dial. Price $1.50.

If your dealer cannot supply you, don't take something supposed to be "just as good." We will take care of your order direct.

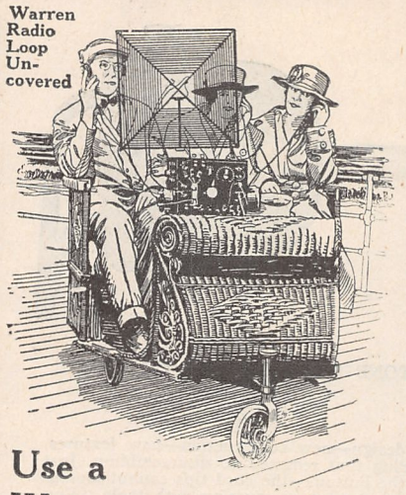
An Announcement!

Due to increased production brought about by popular demand, we have reduced the price of the Model 200 Klosner Vernier Rheostat with Dial from $1.80 to $1.50 effective at once. Get yours to-day!

KLOSNER IMPROVED APPARATUS CO.

2024 Boston Road, *Originators and Sole Manufacturers* **New York City**

Warren Radio Loop Uncovered



Use a Warren Radio Loop

The Up-to-Date Antenna

Makes radio more convenient and enjoyable. Eliminates all interference. Just the thing for portable sets. You can do without a tuning coil by using a variable condenser across the terminals of a Warren Radio Loop. Moisture, dust and fool-proof. Wonderfully well made.

Sold by dealers who sell the best.

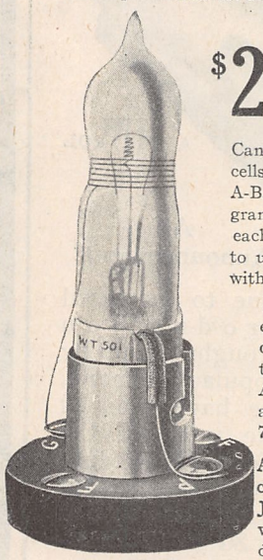
A Type for Every Purpose

Type A-737 (300-700 meters) 6 inches square—non-directional	$10
Type A-7236 (175-1000 meters), 6 inches square—non-directional	12
Type B-2537 (300-700 meters), 18 inches square—directional	20
Type BL-2520 (200-18,000 meters), with honeycomb coil, 18 inches square—directional	25

Bulletin T-102 sent on request

V-DE-CO RADIO MFG. CO.
ASBURY PARK, N. J.
Dept. N

WELSH **PEANUT** TUBE
W. T. 501
"The Tube That Cannot Squeal"
Sold for experimental use as a detector only.



List Price
$2.00
at your dealer or by mail postpaid.

Can be used on 3 dry cells or regular 6-volt A-Battery. Wiring diagram packed with each tube showing how to use the W. T. 501 with any crystal set.

Nickle-plated socket, moulded base, double spring contacts, 50c. extra. Adaptor for standard V. T. Socket, 75c. extra.

Actual size 2¼ inches without base. Jobbers and dealers wire for merchandising plan. Packed 10 in a carton, 10 cartons per case. Orders filled in rotation. Please do not ask us to open an account to ship sample tubes. Samples shipped only at list price which will be credited towards your first stock order.

RADIO RESEARCH GUILD
9-15 Clinton Street **Newark, N. J.**

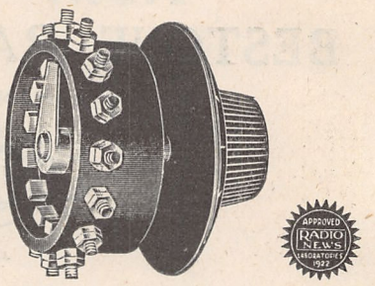
thousands of radio-telephone receiving sets in resonance with the transmitters.

The dignified Secretary of State, Charles E. Hughes, who occupied a front seat in the House of Representatives, was in common with the rural dweller in the isolated farmstead or the boy in the "red schoolhouse" on the hill, in hearing the voice of the Chief Executive of the Nation if the latter perchanced to own a wireless receiving outfit. Fortunately, Mrs. Harding was not denied the privilege of hearing the voice of her distinguished husband on this occasion, since a radio-telephone receiving apparatus was available in the White House, where she has been convalescing from a serious illness for several months. Until her illness the "First Lady of the Land" had accompanied President Harding to the Capitol on every occasion that he addressed a joint sitting of Congress. Unable to attend this time, the "wonderful wireless waves," in part at least, counteracted the disappointment of forced detention in the White House.

The mechanism for relaying the voice of the President to Anacostia was installed by the Western Electric Company, and the local telephone company projected a telephone wire from the Capitol to this point. To the microphone was attached three telephone circuits, with direct connections to the Anacostia Naval Air Station. Only one of these electric circuits was employed in conveying the message of the President. The second circuit was used as a so-called "order wire," thus affording means for telephone engineers to conduct conversations while observing the action of the voice of the President as it was relayed for a distance of about four miles. This observance contemplated the maintenance of an evenness of tone as the voice was impinged on the microphone, and then conveyed by wire to Anacostia. The third electric circuit in the series was an emergency unit, which would have avoided a complete disruption of the service in the event of a breakdown of the other two telephone lines. The system, for the most part, duplicated that in operation when the addresses of the speakers at the dedication exercises of the Lincoln Memorial were relayed to Anacostia and Arlington, from which points they were broadcasted by radio telephone. Also a similar service was maintained at the ceremonies incident to the burial of the "Unknown Soldier" in Arlington Cemetery.

The radio-telephone installation made in the House of Representatives for the dissemination of the message of President Harding is of a permanent character. This fact, however, does not give assurance that the proceedings of Congress will be broadcasted by radio telephony or wireless telegraphy. The "doings of Congress" may eventually be radiated throughout the United States, but such action is not a certainty at this time. Such a service contemplates the use of a high-power radio-telephone transmitting station, the operation of which, of course, involves the expenditure of money. The wireless telephone and telegraph transmitting stations of the United States Navy Department are dedicated to other services, the dispatch of naval business and the broadcasting of serviceable communications from allied Government departments. On this occasion permit to use the radio-telephone transmitter at the Anacostia Naval Air Station was granted by Commander S. C. Hooper, head of the Radio Division, Bureau of Engineering, United States Navy Department. Somebody, however, ventures the prediction that Congress will eventually authorize an appropriation and construct its own high-power transmitting station, whereby the proceedings of the House of Representatives and Senate may be instantly and widely disseminated. This prophecy, sponsored by a radio engineer of a Government

The H. K. Switch



Pat. Pending

The H. K. Multipoint Switch does away with the difficulty of drilling holes in a panel for switch points, only takes a few minutes to mount. Assures a good contact. Is neat in appearance. Contacts are arranged so wires can be attached with ease. Furnished with a 2½ in. dial calibrated to show contact in use.

Awarded Certificate of Merit No. 38 by Radio News Laboratories.

Price complete with Dial $2.00

Special prices to Dealers and Jobbers

HINRICHS KNOOP CO.
Peotone, Ill.

Panel Service

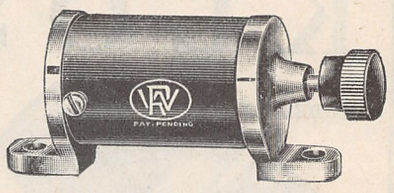
We offer to the amateur and dealer ***Real Panel Service.*** Our panels are cut to your order. Only genuine Bakelite or Formica used.

1/8"	per square inch .02
3/16"	" " " .02½
1/4"	" " " .03

We also carry a full line of radio essentials. Dealers will find it profitable to have our latest price list and discount sheet.

PITTSBURGH RADIO AND APPLIANCE CO., INC.
"Pittsburgh's Radio Shop"
DESK A
112 Diamond St., Pittsburgh, Pa.

R-W Self-Adjusting Crystal Detector



Price with Tested Crystal—$1.50

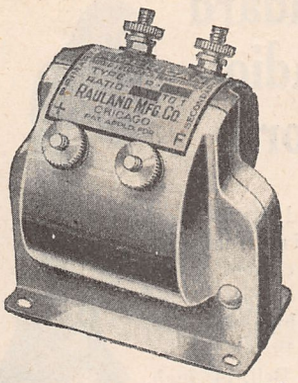
The R-W is a Multi-contact detector that will always find a "live spot" and hold it. 50 per cent more volume in your phones than any other detector on the market.

All that is necessary is to pull out the sliding arm and let go. Contact automatically locates itself on a sensitive spot. It is the simplest detector stand available today.

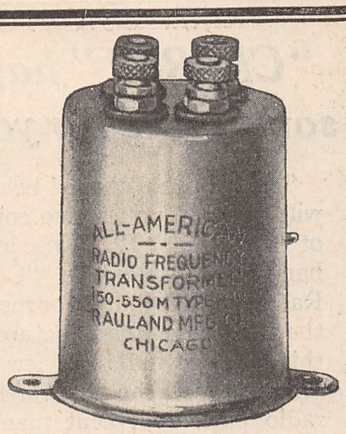
The metal ends are die-cast and polished, nickel plated with a drawn brass adjustment arm and polished black casing knob, making it an unusually attractive as well as efficient instrument.

Write today for our Radio Handbook.

Central States Engineering Co.
224 N. Halstead St. Chicago, Ill.



Radio-Audio
Amplifying Transformers That Amplify!



Wise Radio buyers protect themselves by ignoring the extravagant claims made for untried devices by unknown firms; they *play safe* by buying only the products of this old-established house

"All American" Amplifying Transformers
(Radio and Audio Frequency)

Have the unqualified approval of the best-posted radio engineers of two continents.

Our Radio-Frequency Transformer (Type R-10—150 to 550 meter wave length) strengthens weak signals many fold; gives clear sharp definition; largely eliminates static and other disturbances.

Our AUDIO-Frequency Transformers give such powerful amplification that signals which could otherwise be heard only thru head phones come in clear and strong thru any good loud speaker.

LIST PRICES

R-10—Radio Frequency (150-500 meters)	**$4.50**	**R-13—Audio Frequency (Ratio 10 to 1)**	**$4.75**
R-12—Audio Frequency (Ratio 3 to 1)	**4.50**	**R-21—Audio Frequency (Ratio 5 to 1)**	**4.75**

Send for Bulletin No. 22. It explains the technical and mechanical reasons for the splendid performance of "All American" Amplying Transformers. When you send for it, please give the name and address of the Radio Dealer thru whom you prefer to buy. Don't let anybody sell you a Radio outfit at any price with any other than "All American" Transformers.

RAULAND MFG. Co.
35 So. Dearborn St., Chicago, Ill.

"It's a cinch to put in screws with this screw-driver," says Mr. Punch

IN putting up your radio outfit you will have to use large and small screws. There will be hard and soft materials to pierce. Under the blade of this Goodell-Pratt Ratchet Screw-Driver a screw disappears as if by magic.

The ratchet mechanism is convenient and saves time. You can set it so that the blade turns only to the right or only to the left while at the same time the handle revolves freely. You can also keep blade and handle rigid if you desire.

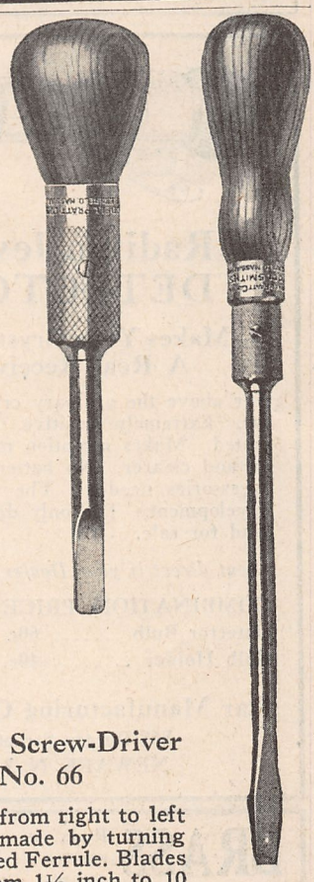
Besides the ratchet screw-driver other Goodell-Pratt Good Tools for radio operators are automatic drills, hand drills, bench drills, plain screw-drivers, tap holders and bench lathes.

Ask any man who uses Goodell-Pratt Ratchet Screw-Drivers what he thinks of them. Then you will understand the reputation their strength, durability and convenience have made.

See your hardware dealer about this screw-driver. If he does not have it or the other Goodell-Pratt tools he can get them for you.

Makers of Mr. Punch

GOODELL-PRATT COMPANY
Toolsmiths
Greenfield, Mass., U. S. A.



Ratchet Screw-Driver
No. 66

Changes from right to left or rigid made by turning the knurled Ferrule. Blades range from 1½ inch to 10 inches in length. Prices run from 90c each for the former to $1.50 for the latter.

GOODELL-PRATT
1500 GOOD TOOLS

"Chi-Rad" has something for you

The coupon attached below will bring to you a free copy of "Chi-Rad's" 1923 loose leaf hand-book. Because "Chi-Rad" is a distributor for more than 21 radio manufacturers this catalog will be a review of practically all the noteworthy radio parts of recent manufacture.

Not only will you find this booklet unusually interesting but at the same time of great convenience.

Mail the coupon today—only a limited number have been published because of expected additions as new radio parts are manufactured.

Chicago Radio Apparatus Co.

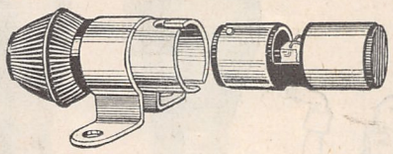
415 S. Dearborn St.
CHICAGO

Gentlemen: Please send me, without obligation, a copy of your 1923 handbook-catalog.
RN

Name.....

Street.....

City.....State.....



Radium Jewel DETECTOR

Makes Your Crystal Set A Real Receiver

Far above the ordinary crystal detector. Extremely sensitive. Easily adjusted. Makes reception much sharper and clearer. No battery or other accessories needed. The very latest development. The only device of its kind for sale.

Sent direct if your Dealer has none.

COMBINATION PRICE $1.00
Detector Bulb .....60c.
Bulb Holder .....40c.

Star Manufacturing Company
868 Bergen Street
NEWARK, N. J.

BRASS Rods in round and square. Machine screws, any size. Tubing and sheet. Nuts. Small drills and taps. Knobs and dials.

ANGIERS, U. S. A.
STREATOR, ILL. BRUCE ST. PLANT

department, is partially based on the anticipated favorable reaction of the precedent established in "blanketing" the deliverance of Warren G. Harding over the continent by means of the radio telephone.

The first step was taken by Mr. Campbell of Kansas, who submitted the following resolution:

H. RES. 465.

67TH CONGRESS, 4TH SESSION IN THE HOUSE OF REPRESENTATIVES.

December 11, 1922.

Mr. Campbell of Kansas submitted the following resolution; which was referred to the Committee on Rules and ordered to be printed.

RESOLUTION.

Resolved, That the Speaker is hereby authorized and directed to appoint a select committee of five Members of the House who shall make full inquiry into the matter of the permanent installation in the House wing of the Capitol Building and in the Hall of the House of Representatives of the apparatus or device, now experimentally in operation therein, designated as a "Public address or voice amplifying system." Such committee may sit during the sessions of the House and shall report to the House at the earliest practicable date its recommendations as to the desirability and advisability of such system for use in the House of Representatives, together with detailed information covering the cost of installation, operation, and maintenance. The Architect of the Capitol Building and the Clerk of the House of Representatives shall assist said committee in the discharge of its duties hereunder.

Super Regenerative Amplification

(*Continued from page* 1455)

upon noting the signs + and — which are next to each of them. This method theoretically decreases the tension between the phone terminals, but this is compensated for by increased regeneration and smoother oscillation.

The plate voltage of each circuit should be maintained at about 90 to 110 volts when U. V. 201's are employed. For Myers tubes 45 to 60 volts are sufficient. With the hook-up given in Fig. 4 the best results will be obtained by using 5 watt tubes with 350 volts on the plate. A Magnavox or Western Electric horn may replace the usual headset.

The best results with all of the circuits given were obtained when the operating characteristics of the tubes, marked 1 and 2, are as nearly identical as possible. Myers tubes seem to be especially adaptable to this type of circuit, as I had no trouble at all with them. With radiotrons and Western Electric bulbs I had to change tubes until I had the correct ones in place.

Fig. 4 makes an excellent C. W. transmitter, when used as either straight C. W., modulated C. W., or phone, by employing 5-watt tubes or larger. The antenna being connected to the plate side of the tickler and the filament to ground. The inductances in this case should be of the "pancake" type and made of copper ribbon similar in style to the familiar oscillation transformer.

We also have in this circuit (Fig. 4) an excellent radio relay, and amateurs who are interested in helping the little fellow along would do well to use this hookup in the following manner, viz.: Those along the way should employ this circuit with four 5-watt tubes and pick up some fellow in the 1st District who is CQing somebody in California per a single U. V. 202, then have the next station en route also tune in to the same wavelength, etc. In that manner we will be able to talk through a series of

Standard Radio Horn

Standard Radio Horn made in rubberoid, black enamel finish. Made in 3 Sizes. 14" Bell 24" high, list **$12.** 7" Bell. 19" high, list **$7.50.** 5" Bell, 14" high, list **$5.** Gem 11" Bell, 14x16", list **$7.50.**

Write for particulars

Manufacturers!
Let us quote you prices on special horns to meet your requirements

Standard Metal Mfg. Co.
231 Chestnut St.
Newark N. J.

NOVO "B" BATTERIES FOR RADIO

22½-45 & 105 VOLTS

NOISELESS
DEPENDABLE
GUARANTEED

ASK YOUR DEALER

NOVO MANUFACTURING CO.
424-438 W. 33rd ST.
NEW YORK

531 SO. DEARBORN ST., CHICAGO.

RADIO DEALERS

In addition to carrying the usual Radio Corporation products, we are now distributors for New York State of the well-known Paragon Radio products, famous throughout the world.
Write for latest bulletin and price discounts.

20th Century Radio Corporation
565 Fifth Avenue, New York City

Genuine* GANAERITE *Crystals

Individually Tone Tested.
Most Sensitive Mineral Rectifier Developed
Mounted Crystals, Postpaid, 50c.
Trade Discounts to Dealers and Clubs.
Now Delivering Promptly on Large Orders.

THE HARRIS LABORATORY
26 Cortlandt Street New York City

ELIMINATE the STORAGE BATTERY

by using BRU No. 4 SOCKET the only socket that takes the dry cell tube. Unconditional guarantee. $1, postpaid.
BRUNO RADIO CORP., 152 West 14th St., New York City

relays from coast to coast with only five watts at each end!

I suppose you will scoff and say that the above statement is a wild dream, dear reader, but from my own experience with the circuit I think the suggestion well worth trying.

As a precaution to those who intend to use any of the hook-ups given in this article, I will say to put a wad of cotton in your ears when tuning in for the first time, because of the terrific howling and the suddenness with which it starts, due to the circuit becoming slightly out of balance.

Damping: Its Meaning Causes and Effects in Radio

(*Continued from page* 1461)

resistance of the circuit, regardless of what the resistance is. Thus it may be the resistance of a spark gap, ohmic resistance of coils, resistance due to dielectric losses in condensers or insulators, antenna or ground resistance, resistance due to corona loss and brush discharge and so on. In other words the total resistance of a circuit due to any causes determines the damping.

If there is an extraction of energy from the circuit due to other causes there will be an increase in the damping. For an extraction of energy from a circuit is equivalent to inserting a resistance in the circuit which resistance dissipates the same amount of energy as was previously extracted. There are two main causes, apart from the above mentioned resistances, for the loss of energy in a circuit. These are (1) radiation and (2) the presence of neighboring circuits. In the first case energy is radiated from a circuit and therefore extracted from the circuit, and results in an increase in the decrement of the circuit. Obviously some circuits radiate more than others and will therefore have a greater "radiation decrement." Antenna circuits have relatively high "radiation decrements" while closed circuits have small "radiation decrements." In the second case the presence of neighboring circuits results in increased damping due to the fact that the neighboring circuit extracts energy by induction. Obviously the closer the coupling between the two circuits the more will the extraction of energy be and hence the greater the damping.

The damping is found to be dependent also upon the ratio of capacity to inductance in the circuit. Without going into the mathematical analysis, it may be said that it is found that the ratio of the total energy dissipated in a circuit to the total energy transferred in one cycle between condenser and inductance is given by the "decrement" of the circuit and is equal to

$$\text{decrement} = \delta = \pi R \sqrt{\frac{C}{L}}$$

where R is the total circuit resistance due to all causes mentioned above, C is the capacity of the circuit, L is the inductance of the circuit.

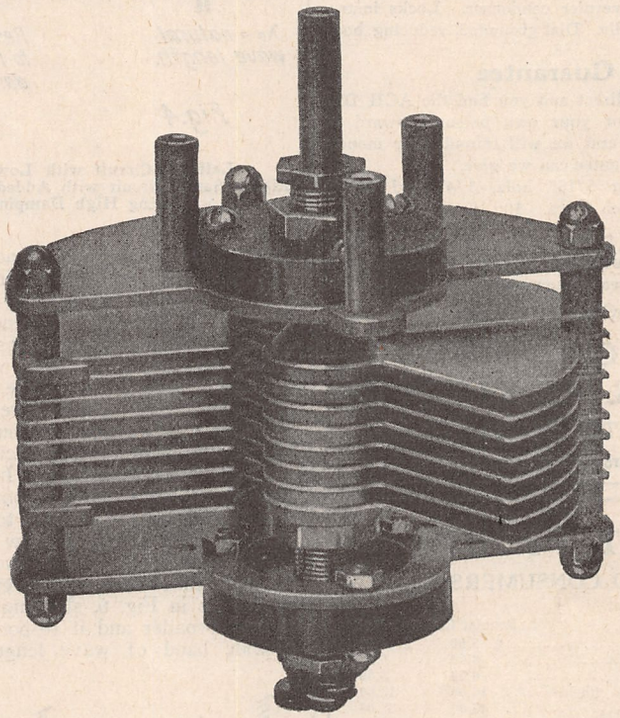
Now that we have an understanding of the meaning of damping and know the circuit factors on which it depends let us consider its various effects in radio design and operation and its importance.

In spark telegraphy the importance of damping is very great. The presence of a spark gap in a radio circuit increases its damping greatly for a spark gap has a very high resistance. Except in a few special cases the sparks are not timed to keep the current at a constant amplitude, and as a result the current amplitude decays after the fashion of the curves in Figs. 2 and 3. This damping in a spark transmitter results in great inefficiency. The greater the damping the greater the inefficiency. For consider the two cases shown in Figs. 2 and 3, the first being a circuit having low damping, the second a circuit with high damping,

ANOTHER WINNER

SE-AR-DE

VARIABLE CONDENSERS



CATALOGUE No. 185 ..... $4.25

Specifications: End Plates 3/32 in. brass, hard rubber dielectric, cone bearings, aluminum plates 22 ga. rotor pigtailed, 5 capacities. Separate Vernier attachment if desired.

TEST DATA AS FOLLOWS:

Capacity Max. .00035. Min. .00015.
Losses at 1000 cycles 19 OHMS.
Power Factor 72%.

R. MITCHELL & CO.

255 ATLANTIC AVE. BOSTON, MASS.

PHANTOM TUNER

$19.75 will bring one of these marvelously sensitive instruments to your address, prepaid. No aerial, ground, loop or radio frequency used. All parts highest quality, Cutler-Hammer, Dubilier, Remler, etc., mounted on genuine Bakelite panel. Complete instructions for wiring furnished. NO SOLDERING necessary. Have music on 15 feet of lamp cord one hour after set arrives. Our Phantom does get over distance and is thoroughly practical with detector only. Wind lamp cord in auto top and tune music while you drive. We've done it often. Send stamp for booklet which tells the Phantom Story.

VESCO RADIO SHOP, 328 Main St., Vacaville, Calif.

Radio Supplies

All Standard Goods--Immediate Deliveries

Distributors for
BALDWIN, BRANDES and BASCO PHONES,
FADA, FEDERAL and MONROE
RECEIVING SETS

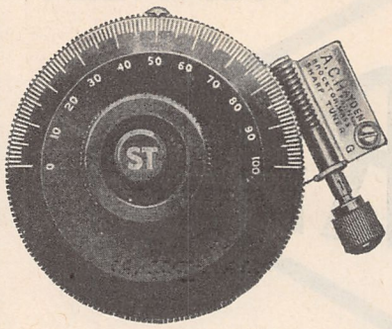
Erla, Acme, Dubilier, Chelten, Burgess, Cunningham. Magnavox and many others. A Complete Line. Largest Stock in the Middle West. Write for latest Catalogue.

DEALERS NEW ATTRACTIVE DISCOUNTS

American Radio Mfg. Co. Dept. A.

107 E. 13th ST. KANSAS CITY, MO.

USE A C H SHARP TUNER DIALS



Your Choice of

Rough tuning with dial or one thousandth of an inch in either direction with the Sharp Tuner Knob. Both controlled by center Knob ST.

Eliminates a vernier condenser. Locks instrument automatically. Dial grounded, reducing body capacity.

Guarantee

If purchased direct and you find the ACH Dial does not warrant your own personal award of merit, return it and we will refund your money, what better guarantee can we give.

Regular fitting 5/16" hole, 1/4" and 3/16". Bushings, 5c. each extra. 10c. for all.

Price of ACH 3" Dial Complete.....	$2.50
With ACH Condenser	4.00
ACH Condenser without Dial	2.50

Free Plan with mail orders on request.

A. C. HAYDEN RADIO & RESEARCH CO.

BROCKTON, MASS., U. S. A.

Mail Orders sent prepaid in U. S. A.

CUT PRICES

TO CONSUMERS

	Regular List	Our List
UV 200 Tubes.....	$ 5.00	$ 4.20
UV 201 Tubes.....	6.50	5.50
WD-11 Tubes.....	6.50	5.50
Baldwin type C Phones.....	16.00	13.00
Magnavoxes	45.00	37.00
Murdock Phones, 2000 ohm....	5.00	4.20
Murdock Phones, 3000 ohm...	6.00	4.90
Acme Transformers	5.00	4.20
Plugs	1.50	.59
Rheostats	1.00	.50
Moulded Sockets.....	.75	.45
B Batteries, 22½-volt.....	1.25	.80
Crystal Detectors.....	1.00	.60
Contact Points, per doz.....	.35 per doz.	.15
Switches, tapered knob.....	.35	.20
Honeycomb Coils, all sizes..25% discount		
Paragon Ra 10.....	110.00	68.00
Variometers	3.50	2.50
Variocouplers	1.50	1.10
Dreyfuss Phones.....	8.00	7.00
3-inch Dials.....	.75	.30
Rheostat Dials.....	.50	.23
No. 14 Hard-drawn Aerial Wire, C ft.....	.60 C ft	.38

We give a discount of 10% on all standard merchandise not listed.

MAIL ORDERS ONLY NO STORE TRADE

Mail check or money order. No stamps or currency

RADIO CUT PRICE CO.

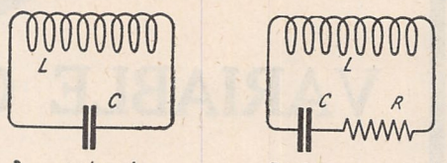
320 Broadway, New York City

F. G. S. CRYSTAL

"W. B. L. received at Sarnia on the F. G. S. Crystal, distance 975 miles. Every Crystal tested for music from stations 300 miles away." Manufactured only by Fred G. Smith, Box 113, Pt. Huron, Mich. In Canada, 302 South Christina Street, Sarnia, Ont.

and suppose that the same power was imparted to each circuit. Evidently this power is more rapidly petered out in the highly damped circuit than in the other. Thus the circuit with the low damping radiates its power over a longer period of time than the other and hence will carry farther. In other words a low damped circuit uses a given amount of power over a longer period of time than highly damped circuit, and hence will be more efficient. A highly damped circuit gives just one rapid impulse to the antenna and then promptly dies out, whereas the low damped circuit uses the same power more economically and makes it last longer.

Another harmful effect of damping will be seen from the following. Suppose we have a circuit as shown in Fig. 4, containing



λ_0 = natural wave length. Fig. 4

Resistance added to Fig. 4 to increase damping. Fig 4-a

Left—A Circuit with Low Damping
Right—Same Circuit with Added Resistance Giving High Damping

only an inductance and capacity. This circuit will have a definite frequency, since both inductance and capacity are fixed. If currents of different frequencies are passed through this circuit and measured, and then plotted as shown in Fig. 5, we will have a so-called "resonance" curve. This shows that the circuit responds very strongly to currents of its frequency, but very weakly to currents of other frequencies even though near its own frequency. In other words this circuit has a sharp resonance curve and will therefore tune sharply to any incoming radio waves. Suppose now we add some resistance in this circuit and again obtain its resonance curve. The curve will now appear as in Fig. 6, showing that its curve is now broader and it responds strongly to a wide band of wave lengths. In other

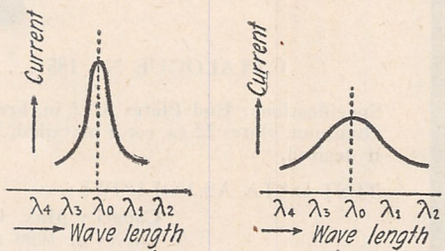


Fig. 5 Fig. 6

Left—A Resonance Curve Plotted Against the Circuit of Fig. 4
Right—Curve Corresponding to the Circuit of Fig. 4-a

words by increasing the resistance of the circuit, which is the same thing as increasing the damping or decrement of the circuit, we have changed a sharply tuned circuit into a broadly tuned circuit. This is very bad for radio transmission or reception. In the case of spark sets we have these broadly tuned waves on account of the high damping. Consequently even if a receiving circuit is not tuned to the transmitting the transmitter will interfere with it, because it transmits over a very wide band of wave lengths. It is for this reason that spark transmitters today are coming into great disfavor because they cause most of the interference with people who are listening to the broadcasting.

However not only does this apply to the

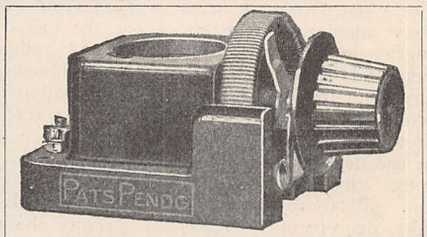
Recognized as best by largest Radio Manufacturers

Buy It In Cartons

Copper Clad Steel Company

New York Chicago

Braddock, P. O., Rankin, Pa.



KING RHEO-SOCKET

Price $3.00, f. o. b., N. Y. C.

This rheostat embodies compact, increased efficiency, having shorter connections and less wiring. It will bring in stations you have never heard before.

Make this King Rheo-Socket a part of your up-to-date set. A high-grade article in red bakelite with phosphor-bronze contacts and alloy resistance wire.

For base or panel mounting

KING AM-PLI-TONE

82 Church St., New York City

Mfrs. of the famous King Am-pli-tone

Jobbers:

Wire or write for interesting proposition.

Parts and Accessories for makers of radio apparatus

GERACO

PROVEN RADIO PRODUCTS

Details and Prices on request

GENERAL RADIO CORPORATION

Mfrs & Distributors of

First Quality Radio Equipment

including *MUSIC MASTER RADIO AMPLIFIER*

624-628 Market St. Philadelphia

RADIO SERVICE PRODUCTS

Tubular Grid Leaks (.2, .5, 1.0, 1.5, 2.0, 30 megohms)	$0.50 each
Tubular Grid Leaks mountings.....	.35 each
Single V. T. Sockets Type S-10.....	.90
Triple V. T. Sockets Type S-4	2.70

RADIO SERVICE & MFG. CO. (Est. 1918)

Sales Div. 507-5th Ave., N. Y. C.

Factory—Lynbrook, L. I.

We carry a Complete Line of Radio Apparatus

RELIABLE RADIO APPARATUS

Our price list, mailed Free on request. Contains complete list of reliable Radio Sets and parts—Grebe, Paragon, Radio Corp., etc.

Mail orders given prompt attention
Write today—Special Terms for Dealers

The Klein Radio & Electrical Supply Co.

48 Fulton St. and 34 Park Place NEW YORK, N. Y.

highly damped, broadly tuned spark transmitter but the same reasoning applies to the receivers. For receivers may be poorly designed to have high resistance and the wrong ratio of inductance and capacity. As a result a receiver may also have a high damping and hence be broadly tuned. Thus even if a transmitter has a low decrement the receiver may be interefered with because its own tuning is broad. This may occur even if the transmitter has a continuous wave. Here then we have a case where the current amplitude is not damped, and in which the damping effect of a circuit is nevertheless displayed. We see then the importance of having a very low damping both in transmitters and receivers for less interference is thereby created.

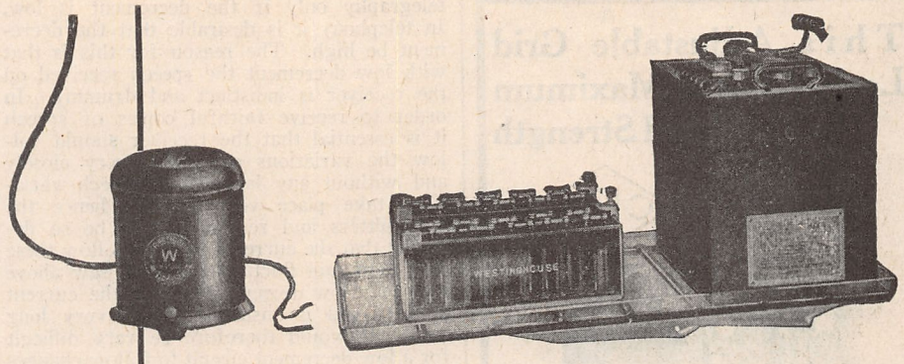
Often the high damping is due to poorly designed antenna and ground system. Care should be taken that these two very important parts of the set have as little resistance as possible. The actual design of these two parts will be taken up in a special article on antennae later in the series.

In the case of transmitting antennae, what is desired is maximum radiation of energy. Radiation of energy, we saw, is one cause of high damping since energy is extracted from the circuit. Thus in transmitters the object should be to decrease the wasteful resistance and hence decrease the damping due to this, but to also increase the radiation decrement, for this will mean that more energy is being radiated. Here is one case where high decrement is desirable.

The control of the damping factor is very important in the design of wave meters. The accuracy of wavemeter measurements depends largely upon the sharpness of tuning of the wavemeter. We saw above that a circuit with high damping does not tune sharply. Hence it is important to design wavemeters carefully so that their decrements are low. The coils must be wound to have a minimum resistance in the first place. Secondly the ratio of capacity and inductance must be proper. From the formula given above for the decrement of a circuit we see that high capacity increases the damping. Hence the value of the capacity must be kept within bounds. Further the inductance must not be too low or else the damping will increase. However, a high inductance means more wire and therefore high resistance. In other words there is conflict here which must be properly solved if low damping is to be secured. This entire subject is so well taken care of in an excellent article on the "Design of Wavemeters" in the Sept., 1922, issue of the RADIO NEWS that nothing further need be said here, but the readers are referred to the above mentioned article.

In the above cases we have seen how a high damping wactor was very undesirable and produced harmful effects. There are cases, however, where a high damping is very desirable and these will now be considered. First in the case of telegraphy on sea when it is desired to transmit distress signals when the ship is in danger. In sending distress signals it is necessary that every possible ship on the sea should hear this signal so ttat aid will be promptly forthcoming. However it is possible that the receivers on these ships will be tuned to different wave lengths. Hence in order to have the distress signals come in on all these receivers the wave radiated from the transmitter of the distressed ship should be very broadly tuned so that it covers a wide band of wave lengths. We saw above that high damping resulted in a broad wave. Hence in such cases the broad wave or high damping is not only desirable but necessary. In such cases the operator frequently works with his spark gap directly in the antenna which results in very high damping and very broad tuning.

High decrement is also of importance in the reception of radio telephony. Except for the special case cited in the previous paragraph best results can be obtained in



Radio is full of interest—fascinating. But you want only the clearest, fullest tones you can get. These are possible only with batteries that are absolutely RIGHT.

Get a Westinghouse Radio Power Set

and enjoy radio at its best. Set consists of a Westinghouse "A" Battery, two or more Westinghouse Radio "B" Batteries, a glass tray and an inexpensive Westinghouse battery charger.

With this set you can always be sure of ample current and clear, strong reproduction. You can also cut in with additional storage batteries and enjoy concerts from more distant broadcasting stations.

WESTINGHOUSE STORAGE BATTERIES are made in voltages and amperages suitable for all the popular size radio outfits. Radio dealers and more than 2200 Westinghouse Battery Service Stations have them for you.

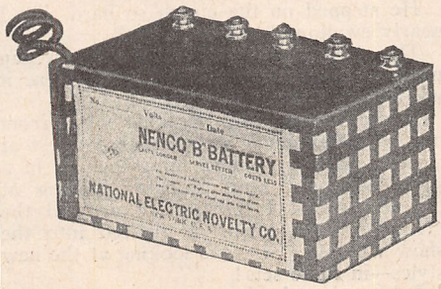
Write us for illustrated folder on "Westinghouse Radio Storage Batteries"

WESTINGHOUSE UNION BATTERY CO., Swissvale, Pa.

WESTINGHOUSE

RADIO "A," "B" and "C"
BATTERIES

"NENCO" "B" Batteries



THE MOST EFFICIENT MADE

Last Longer—Serve Better—Cost Less

Made In
All Standard Sizes and Voltages

National Electric Novelty Co.
53 Walker St. New York, N.Y.

telegraphy only if the decrement is low. In telephony it is desirable that the decrement be high. The reason for this is that with low decrement the speech received on the receiver is indistinct and drummy. In order to receive faithful copies of speech it is essential that the receiver should follow the variations of speech very closely and without any lag. Now speech variations take place very rapidly, hence the transmitters and receivers must be so designed that the currents in them follow these variations and fluctuations. We saw above that in a low decrement circuit the current persists and is sustained for a very long time. It would therefore be very difficult for a low decrement circuit to follow changes and fluctuations very rapidly, since the currents in such circuits tend to persist. However in a high decrement circuit we saw that the current does not persist and is not sustained. Hence a high decrement circuit is more capable of following fluctuations and variations rapidly and without lag. It is for this reason that best speech is obtained on receivers having high decrements.

In general, however, for most work in radio communication low damping is desirable. It is for this reason that spark equipment and other apparatus producing damped waves are fast going out of use and in their place is coming continuous wave apparatus. A minor advantage accruing from this is that calculations become somewhat simpler. With damped waves it was always essential to take into consideration the decrements of transmitter and receiver in all calculations, and this made things very cumbersome and complex. With undamped waves this is no longer necessary and calculations approach more nearly those of simple alternating currents.

The Old-Time Ham Gets Out

(*Continued from page* 1471)

for the most abominable Manila cigar in the house to appease my present unsatiable taste for murder in the first degree. The clerk dug up what appeared to be the end of an old hemp rope which must have died of arterio sclerosis in the oil fields or in a gas producer. He smiled affably and said, "Mr. Jones, if you will stand by for a few minutes you will be able to hear our new——"

Ye Gods and small pescados! Up on the wall where I had not yet been made cognizant of its presence, was the horn of a loud speaker attached to a radio receiver; it began to speak: "The first number from KOWXP tonight will be by Professor ZSXDFGLKPC on the violin. He is performing especially for this station at the request of our many fans and——"

I rushed into the street fearful that the loud speakers was at my heels in hot pursuit.

"Where to?" said the driver. "Where do you want to go?"

I told him emphatically where to go!

He said, "All right. old top, we will at least try, but it will take a lot of gas and probably scratch the paint. Nothing in my young life though, the meter is going round and round."

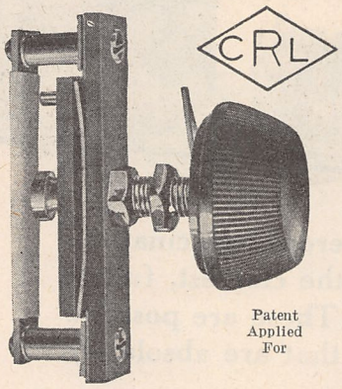
He stepped on the clutch so hard that I nearly swallowed my back teeth.

The old meter buzzed like the rotary gap next door—blankety blank blank. Here it was again, radio, radio, radio!

We passed up town. Seeking solace from my mental agony, I looked with interest at a most charming young thing looking in a show window. Hm, probably looking at the new styles, I thought. I ordered the driver to slow down. I glanced into the show window. She was looking at the new styles—in radio sets!

I shouted to the driver to start, and quick-

This Adjustable Grid Leak Assures Maximum Signal Strength



Patent Applied For

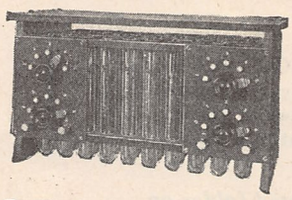
A CRL Adjustable Grid Leak enables the operator to adjust the grid potential to the exact value that provides the *maximum signal strength.* The resistance of the leak can be gradually and smoothly changed to any value between ½ and 5 megohms.

The distance between the binding posts is 2¼ inches — just right for mounting a standard grid condenser. If desired, a C R L Adjustable Grid Leak can be furnished with a condenser as shown in the illustration above.

CENTRAL RADIO LABORATORIES

Makers of C R L Rheostats, Vernier Rheostats, Potentiometers, Vernier Potentiometers and Grid Leaks.

305-16th Street
Milwaukee Wisconsin



KICO RadioStorage "B" Batteries for EFFICIENT Receiving

THINK over the following FACTS before buying again.

1. KICO "B" batteries allow single cell variations by means of switches on mounted panels. (The first in the market with this feature.)
2. Alkaline type.
3. One charge lasts from three to six months in the detector plate circuit.
4. Rechargeable from your 110-volt A. C. line in connection with the rectifier supplied.
5. Neat, efficient and compact.
6. Unlimited life.
7. Your money back if unsatisfied within a 90-day trial.

	(Plain)	(With Panels)
16 cell 22 volt	$6.50	....
24 cell 32 volt	8.00	$12.00
36 cell 48 volt	10.00	14.00
50 cell 68 volt	12.00	17.00
78 cell 100 volt	16.00	21.00
108 cell 145 volt	21.00	26.00

Literature gladly furnished.

KIMLEY ELECTRIC CO.
1355 Fillmore Avenue Buffalo, N. Y.

VARIABLE CONDENSERS

3-Plate Vernier	$0.75
23-Plate .0005 Mfd.	1.75
43-Plate .001 Mfd.	2.25
24-34-Plate Balanced Cond.	3.75
44-Plate Balance Cond.	4.75

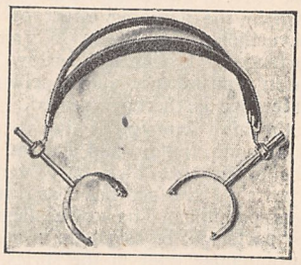
Aluminum Plates, accurate spacing. Get these condensers and improve your set. Shaft runs in bearings. Money back if you are not satisfied.

MONTROSE MFG. CO.
1200 Bedford Avenue Brooklyn, N. Y.

USE OUR FACTORY

Manufacturers and dealers who require wireless apparatus or parts can obtain quantity output and guaranteed delivery.

We have over half a million dollars invested in special and automatic machinery. Wire and metal products our specialty. Send sample your product and receive our quotation on making.



HEADBANDS

You know this headband. We can make prompt shipment on your order. Get our prices.

THE AUTOYRE COMPANY
Oakville, Conn.

Radio Sets and Parts

We manufacture sets and carry a large stock of all well known sets, such as Westinghouse, Clapp Eastman, DeForrest, Grebe, G E, Etc.

We also carry a complete stock of Magnavox, Head Sets, and Parts, and supplies of all kinds.

Our prices are lowest, as we have a very low overhead expense. Send for our RADIO CATALOG.

Washington Automobile Supply Co.
Established in 1908
WASHINGTON ILLINOIS

G-W Slider

REDUCED TO 15c

GEHMAN & WEINERT
42 Walnut St., Newark, N. J.

A QUALITY BATTERY
Guaranteed Two Years

Marko Storage Battery Company
1404 Atlantic Ave.
Brooklyn, N. Y.

Phone Connectors
Connect Phones in One Second

Also used as Ground and Aerial Wire Connector
No screws to tighten or get lost.
Makes absolute contact and fine appearance.
Sent prepaid anywhere in U. S. 35c per set.

Attractive proposition to Dealers and Radio Manufacturers.

SCREW MACHINE SPECIALTY COMPANY
Screw Machine Products
314 29th Street Pittsburgh, Pa.

ly too; passing vehicles danced before me in a scintillating stream. The driver happened to glance back and said:

"Say, old top, you look done out, maybe this will soothe your nerves."

He snapped a switch. A concealed antenna in the cab top started pouring out—"Sw-heeet Bu-hunch of Da-haisies Fresh from the Duhel-l-l," from some broadcasting station down town.

I fainted on the seat. Later I became aware of the fact that I was in a place where there yawned labyrnthic depths and sheer towering precipices. On closer scrutiny I saw row upon row of dials, scales, knobs and pointers. Vacuum tubes with grinning faces and massive proportions grinned and winked at me from great heights and bottomless depths. Row upon row of them. Mile upon mile of them. League upon league of them. Er—upon—er.

I stood in Municipal Court next morning; a white-haired judge asked what the charges against the prisoner were. I looked about and discovered that I was the prisoner in the dock.

The prosecutor stood up and pointed an accusing finger directly at me. I trembled from my ground connection up.

"Insanity! He tried to buy all the radio apparatus in the store."

Faces turned appealingly, sympathetically, toward me. I looked at the Judge. He was smiling. in fact he was smiling humanly. "Mr. Jones, you are discharged, and if I were you I would institute charges for false arrest."

The Judge turned back to the Court. "The Court is dismissed for an intermission, while we listen to the radio concert." He pressed a button on his great desk and leaned back comfortably in the massive oaken chair. A concealed loud speaker started almost at once: "The first number from KXPZX will be a lecture on power of will by Professor Moneybits!"

I crumpled in a heap.

At home the wife was smoothing down the pillows and crooning like in the old days when we first found out that it was not cheaper for two than—etc. You know it by heart.

"Dear." said the wife, "the old paper man came this morning. I gave him some books," she said significantly. "Uh huh," I said, feigning sleep from the shock of my late experiences in fleeing the radio bug.

However, that was some time ago. Last night I sat up until 4 A. M. and copied FL and LCM and POZ. Am I through with radio forever?

Well, drop around some time after I get the five-stage radio frequency working and I'll tell you. Just put up a beverage antenna and we have another beverage appliance in the cellar which is not built for undamped work. I'm as busy with radio again as a one-armed paperhanger with the hives.

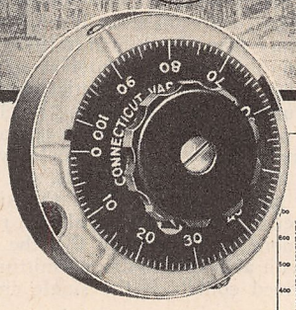
Vive le radio! I'm back again. Mr. Steinmetz is right. You know, radio over instinct, all that, and then some.

ENOUGH SAID

A friend of mine was listening one night to the bedtime story teller of WOC, Davenport, Iowa. A station in Kansas City was sending on about the same wave-length and would occasionally come in louder than Davenport.

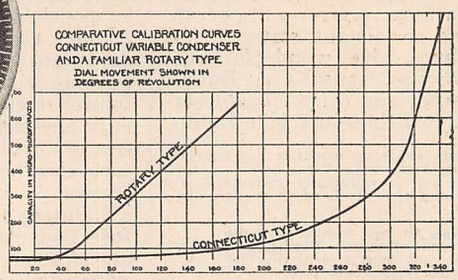
The story-teller at WOC said,—"and the little girl had long yellow curls and beautiful blue eyes!" Right at this point the station at Kansas City grew louder and the speaker there whispered dramatically,—"and no backbone at all!" The speaker there was talking about fish!—*Contributed by Louis Dawson.*

CONNECTICUT RADIO



J-108 *$5.50*
Panel Type Variable Condenser

Portable Type
J-107 *$6.50*



A Greater Working Range

The most useful portion of condenser adjustment spreads over a dial turn 2½ times greater in the CONNECTICUT Variable Condenser than in the familiar multiple plate type.

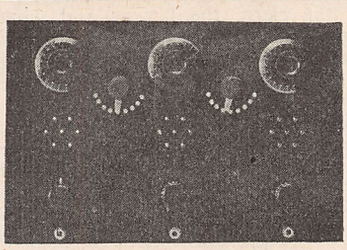
The well-designed circuit for short wave lengths usually employs capacity not exceeding 400 micro-microfarads. The CONNECTICUT Condenser has over 300 degrees of dial movement below that capacity, against only 120 degrees in the plate type.

The end of the scale, where capacity change in the CONNECTICUT type is somewhat more rapid, is generally little used in any condenser. In practical operation (below 400 mmf.) the gradual capacity change of the CONNECTICUT Condenser and the greater dial rotation permit most accurate settings.

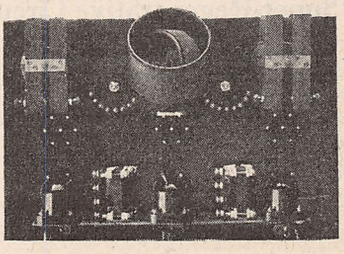
Every experienced operator will appreciate the significance of the above curves, and recognize that the CONNECTICUT Variable will be an addition to any set.

A booklet describing the condenser more fully will be sent upon request

CONNECTICUT TELEPHONE & ELECTRIC COMPANY
Meriden Connecticut



This Tuner, Detector and 2-Stage Amplifier
(Unwired)
Only $35.00



To Increase the Radio-Buying Power of Your Dollar—

Set B consists of two Variometers, Variocoupler, and all accessories to make up an efficient tuner, detector and two-step amplifier. All material is rigidly mounted on 12 in. x 18 in. x ¼ in. hard rubber panel, dials, wire with spaghetti tubing and diagrams showing 'you how simple it is to wire this set are furnished. Only.. **$35**

Series A consists of tuner of the set illustrated, plus the detector unit. All material mounted on 7 in. x 20 in. x ¼ in. hard rubber panel, dials. Wire, tubing, and wiring diagrams are furnished with the set. The price is only **$20**

Let us tell you about our Armstrong Super-Regenerative Receiver unwired on hard rubber panel.

Drop us a line for our list of other specialties

C. & K. RADIO MFG. CO., 299 7th Street, Brooklyn, N. Y.

The Heart of Radio Frequency

Is The Transformer

And Your Success in Getting Distance and Distinctness Depends On the Efficiency of Your Transformer

Do not condemn Radio Frequency because you have used poor Transformers. The RT-5 (150 to 300 meters) and the RT-6 (300 to 600 meters) have been tested severely by experts in various parts of the country and are proven without equal in tone quality and distance. They are an absolute necessity to the enthusiast who desires to get the best results from his radio set. With the RT-6 and RT-6A transformers, a loop receiver will operate a loud speaker on distant stations and you can easily receive wonderful programs from Chicago, Kansas City, Dallas, Atlanta, Winnipeg and other distant stations within a two thousand mile radius.

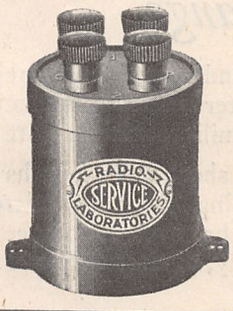
Order by type number, accept no substitute and remember that all Radio Service Laboratories Transformers are individually triple tested and unconditionally guaranteed. For sale at all reliable electrical or Radio Stores or order direct from us.

Send ten cents for new booklet on Radio Frequency with schematic diagrams — a most valuable and helpful publication for the radio amateur and expert.

RASLA SALES CORPORATION

National Distributor

Dept. A, 10 East 43rd St., New York City.



LOOP ANTENNA Problems Solved!

BROADCASTED messages, news, lectures, music and sporting events can now be received clearly more than ONE HUNDRED MILES distant from broadcast stations with a two-tube receiving set and an indoor loop antenna.

This epoch-making invention is described fully in our 52-page book by George J. Eltz, Jr., E.E., A.I. E.E., on the construction and operation of

"The ARMSTRONG Super-Regenerative Circuit"

including 21 photographs and Hook-Ups, in simple non-technical radio language. Contains complete description of each of the three circuits invented by Major E. H. Armstrong, E.E.

Price **$1.00** Per Copy.

DO NOT SEND STAMPS

RADIO DIRECTORY and PUBLISHING CO.

47-C Vesey St. New York City

Results of the $500 Prize Contest

(*Continued from page* 1451)

people who take an interest in it increases. Just as the talking machine industry could not thrive if it had to depend for its business on a handful of musicians, so the radio industry cannot depend upon the handful of technical amateurs for its business. It must interest the average man and woman in the street.

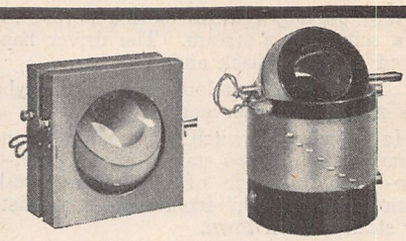
To secure this essential interest of the enormous lay public it is essential that the radio instruments, like the talking machine, be models of simplicity as far as operating features are concerned. And simplicity today means a minimum of controls, and preferrably a single control. It is the single control receiver which will popularize radio more and more, and it happens that the only type of circuit available to-day permitting of such simplified control is the single circuit receiver.

Naturally the single circuit receiver therefore finds favor with the layman, but its prevalent use has brought in its train difficulties and a big problem. The single circuit tuner is of course less selective than a double or triple circuit tuner. As a result, with transmitting amateurs around him particularly in congested districts, the layman has experienced considerable code interference while receiving the broadcasting. The radio lay public therefore insists that the amateurs keep off the air during broadcasting hours. The amateurs just as staunchly insist on their right to the air, and protest against what they consider the arrogant interference of an uninformed public which is just entering the radio circle. They generally cite their long standing in the radio community, that they have made radio what it is to-day, and that the single circuit tuner causes most of the layman's interference.

It is true that the amateur has made radio history and is in the vanguard of the radio army. The amateur, however, cannot rest on his laurels or past performances if the layman—who is to furnish the radio industry with practically all of its business—is interfered with. It must be remembered that the average non-technical layman who constitutes the bulk of the nation is being sold on a big, brand-new idea—RADIO, and he has to be catered to and his requirements have to be met. If he is told that his requirements cannot be fully met and he must yield because some amateurs were here first, he will rightly answer in no uncertain terms that he cannot embrace this new idea of radio and that the amateurs can have the field to themselves all of the time. Which means that the radio industry goes back to what it was two or more years ago, a picayune, little industry.

As a matter of single circuit receivers causing the trouble the amateur must remember that Tom Jones, the bookkeeper, the salesman, the clerk, the lawyer and what not, knows as much about technical radio as he does about music. He may appreciate both, but he knows little about either. The reason there is a talking machine in almost every home is that talking machines were not designed for skilled musicians, but were designed for average musically unskilled persons. And there will be a radio set in every home—which is the aim of the radio industry—when radio sets are designed in the same way. This means a minimum of controls on the receiver and to-day the single circuit tuner is about the only tuner that permits such easy control. And the radio industry has the single circuit tuner to thank for whatever popularity radio has achieved to-day.

If the amateur's transmission were of material benefit either to the public or the radio art there might be some ground for their stand on the question. But it serves



Ra-Fone

Variometer $2.40

Stators 4½ inches square, rotors 3½ inches. Double cotton covered windings, No. 22 wire set in insulating varnish. Flexible leads to 3½-inch secondary. Clear insulating varnish finish. Mounts flat to panel with 2 countersunk screws.

Vario-Coupler $2.40

Primary wound on 4-inch black di-electric tube with 9 single taps and 8 nine-turn taps. Taps are soldered on brass strips and turned to allow easy soldering connection for user. Rotor 3 11/16 inches in diameter, making very close coupling with primary. Rotor finished with flexible leads through hollow rotor shaft. Primary and secondary both wound with No. 22 green silk covered copper wire — 44 turns on rotor, 80 turns on primary. Finished with clear insulating varnish.

Both guaranteed to be of very best material and workmanship and to receive perfectly up to 500 meters when properly installed. Immediate shipment by parcel post on receipt of price. Satisfaction guaranteed or money back.

Ra-Tone Electric Co. 216 Park Place West DETROIT, MICH.

—IT REPLACES

rheostats

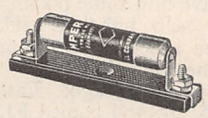
meters

expert operator

AMPERITE

Automatic Filament Current Adjuster

RELIEVES YOU OF ALL TUBE TROUBLES



$1.10 with mounting

Manufacturers

RADIALL COMPANY

99 WARREN STREET NEW YORK

BRIGHT STAR

"B" BATTERIES & FLASHLIGHTS

Noiseless *Long Service*

Long Shelf Life *Dependable*

Bright Star Battery Co. NEW YORK CHICAGO OREGON

MURDOCK RADIO

STANDARD APPARATUS SINCE 1904

"Better Than The Best"

AERIAL-A

The Radio Tube Set That Made Good In a Night

WESSCO QUALITY

W.E. Supply & Service Corp. 18 Murray St. N.Y. U.S.A.

no advantageous purpose. The mere act of relaying and seeing how far one's transmitter can reach, while of personal interest and pride to the individual amateur, has not any other importance. On the other hand broadcasting is gradually assuming the importance almost of a public utility, and as such is deserving of the first consideration.

The technical knowledge and ability possessed by the amateur is of tremendous potential value and it would be a great loss to the radio art should anything occur to make the amateur's interest in radio wane. However, from considerations enumerated above his chief radio occupation, *namely relaying, is of no value in itself and must give way to the broadcasting.* The only way out of the dilemma is the opening of *new spheres of activity for the technical amateur.*

From this point of view the writer has a solution which may sound very ambitious, but which has the merits of affording sufficient scope for the amateur's technical interest and affording a minimum of interference with the broadcasting.

Instead of an Amateur Radio Relay League it is suggested that an Amateur Radio Research League be formed, which may be a nation wide organization just as the former is. The various existing amateur stations are potential miniature laboratories which by proper direction can be effectively utilized in securing data and information of great importance to the art. Thus there are a great many problems which are functions of time, locality and climate; as for example, the intensity and directional effect of static, if any; the problem of fading of signals, etc. Range data of telegraph and telephone transmitters are very meagre. By properly co-ordinating the efforts of the various stations throughout the country data of inestimable value may thus be obtained. Besides there are any number of problems which can be taken up and investigated with the facilities the amateurs possess. This would require, of course, very good organization, with central headquarters and districts divided under the supervision of the most capable amateurs. The ability and a considerable part of the facilities are available. What is lacking is the organization and exact plan of procedure. A nation wide organization for systematic relay transmission was efficiently accomplished and with the same talent an organization for this far more important purpose of research can also be accomplished. It is obvious that the purpose of avoiding a clash with the newcomers will be thereby effected and at the same time the ability of the amateur will be expended in a manner far more beneficial to the public and the art than heretofore.

The Radio Amateur

By HUGH H. WINGETT

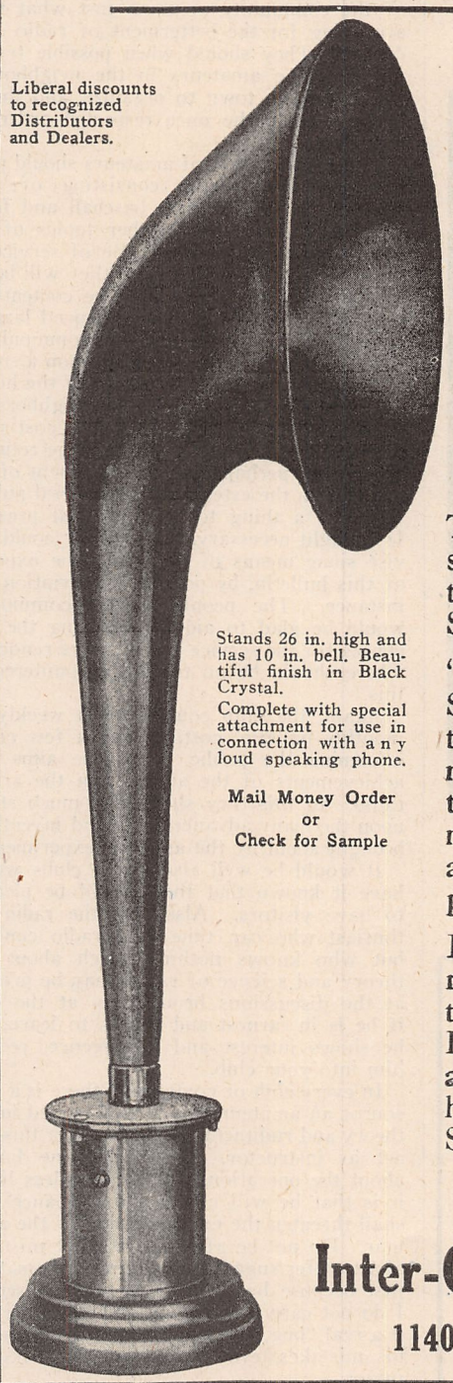
THIRD PRIZE

The radio amateur's trouble to-day is that he does not advertise himself in the right way. A few so-called amateurs or "hams" congest the ether by sending more or less meaningless messages, using a kilowatt of power, to a brother "ham" around the corner. The radio public which is trying to listen in on a radio program or musical concert, is of course drowned out and the blame is laid on the shoulders of the amateur, thereby giving the whole body of amateurs over the entire country a black eye, for the misdeed perpetrated by a few "hams" who don't know the meaning of tuning, 200 meters, and broadwave. There is no reason why this condition should exist. The well meaning, hard working amateur should take it upon himself to remonstrate with the owner of such a station or exterminate him, thereby doing away with the nuisance that is menacing their very existance.

"WOODEHORN"

Loud Speaker

$7.50 LIST PRICE



Liberal discounts to recognized Distributors and Dealers.

Stands 26 in. high and has 10 in. bell. Beautiful finish in Black Crystal.

Complete with special attachment for use in connection with any loud speaking phone.

Mail Money Order or Check for Sample

Most Startling Loud Speaker at Most Startling Price

The name "WOODEHORN" suggests without much effort the character of the Loud Speaker.

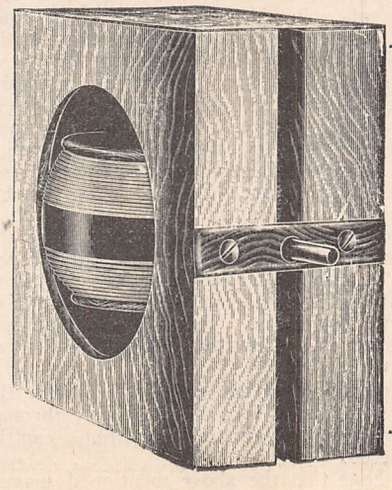
"WOODEHORN" Loud Speaker brings you closer to the broadcasting station, insomuch that the rich mellow tones are brought out in such natural clearness that you can almost feel the living breathing presence of the artist.

If you would have tones of a rare violin — then do not hesitate to try a "Woodehorn" Loud Speaker. Its results will astound you. Hear "Woodehorn before you stock Loud Speakers.

Manufactured by

Inter-Ocean Radio Corp.

1140 Broadway, N. Y. City



$2 MADE TO SELL FOR $5.00

150—500 METERS

¼" SHAFT

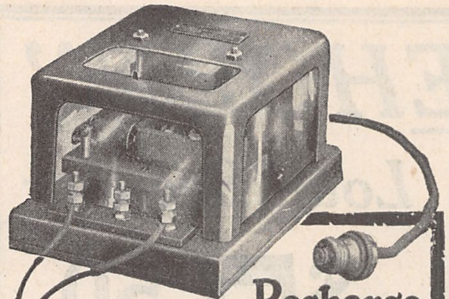
FAHENSTOCK CONNECTIONS

Send for Complete Catalogue

DAVID KILLOCH CO.

57 Murray Street, New York

WHOLESALE RETAIL



Recharge Your Battery at Home

Charges Both A and B Radio Batteries

Don't be without the use of your Radio Receiving Set while your battery is being charged. Get a Valley Charger and charge your battery right at home.

Attach the Charger to your home lamp socket—attach the clips to the battery terminals and you will get a quick, tapering charge which just exactly charges your battery, but cannot overcharge or harm it in any way.

Will charge the A 6 volt battery at a 5 ampere rate, and the B 22½ volt battery at the required ½ ampere rate. 45 volt B batteries may be connected in parallel so that they can also be charged.

SATISFACTION GUARANTEED. If your local distributor cannot supply you, write direct to

VALLEY ELECTRIC COMPANY,
Department R, ST. LOUIS, MO.

- - - - - - - **Mail the Coupon** - - - - - - -

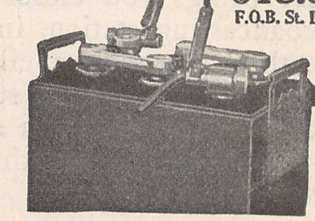
Valley Electric Co., Dept. R, St. Louis, Mo.

Gentlemen: I am enclosing money order (or check) for $18.00, for which send me a Valley Battery Charger with five-panel glass display case and indicator. If not satisfactory, I will return it and get my money.

Name

Address

$18.00
F.O.B. St. Louis



High Efficiency

HEAD SETS

Army and Navy Type:
2500 ohms, per pair $10.00
3200 ohms, per pair 12.00

Swedish-American Type:
2200 ohms, per pair 8.00

Victor Type:
Single coil, double magnet 6.00

Jacks, Plugs, Microphones and other Radio Parts
Ask for our Liberal Trade Prices

American Electric
COMPANY
CHICAGO - U. S. A.

This done, the amateur should try to organize the surrounding amateurs, and form a club, having operating rules and regulations. They should, where possible, hold concerts, showing and informing the people of the community or town just what they are doing for the betterment of radio conditions. They should when possible try to influence the amateurs in the neighboring community or town to organize, and thereby perpetuate the once respected order of amateurs.

This organization of amateurs should publish a daily bulletin, consisting of: the weather reports, boxing, baseball and football results, and many other topics of interest that are broadcast. Be of service to those of your community and they will begin to appreciate the amateur. The contents of this bulletin would of course depend largely upon the people of the different communities. This bulletin could be fastened upon a small, neat sign board, placed in front of the house of each amateur, where the neighbors in passing could read it. It would cost next to nothing and would bring in large returns. Not money perhaps, but reinstatement of the amateur in the esteem of the general public, which is a thing to be desired at present. If thought necessary, the amateur could devise some means of defraying the expense of this bulletin, by popular subscription for instance. The people of the community would be glad to aid in defraying the expenses for the service and pleasure rendered. There should be no trouble encountered in this.

Again, the club could issue a weekly or monthly bulletin, costing only a few cents, informing the public, as to the aims and achievements of the amateur in the art of radio. In this they should lay much stress upon the many advancements and inventions brought about by the amateur experimenter.

It would be well also if the clubs would have it known that they would be pleased to have visitors. Also that the radio enthusiast who can tune in a radio concert, but who knows nothing much about the theory and science of radio, may be present at the discussions brought up at the club if he is in earnest and wishes to learn. If he shows interest and intelligence, receive him into your club.

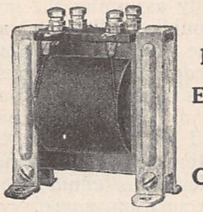
In every club or community there is a person or an amateur who is well versed in the theory and rudiments of radio. Let this one act as instructor. The more one knows about the operation of a set, the less likely it is that he will create a disturbance that shall threaten the extermination of the amateur. Do not be afraid to correct mistakes and to offer suggestions to another amateur, just because he happens to be your senior. I do not care how old an amateur is; if he is a real "bug," he won't resent being shown his mistakes, even by one many years his junior.

By now the amateur should recognize his danger and try to organize and cooperate with others in order that he may avoid bringing down upon himself the wrath of the radio public. It will never do to have them turn against us, for they outnumber us and practically control our future, and our very existence. They are in the majority, and they will hardly tolerate anything which they think will deprive them of their amusement and pleasure. We had better squelch these "brass-pounders" who create such a disturbance, and who cause the ire of the pleasure seekers to be directed against us, or the "Ancient Order of Amateurs" is likely to be presented with some such motto as: "Say it with flowers," or "Peace be with you forever more," meaning that we will pass out of existence.

To my mind the remedy lies with the amateurs themselves and it is only through them that the existing conditions can be bettered.

I hope that the above mentioned sugges-

"SUPERLATIVE" AMPLIFICATION



No. 41

You Can
Increase Your Range
Eliminate Howling and Distortion
Bring Out the Full Clear Tone in Volume
WITH

JEFFERSON

Amplifying Transformers

Furnished in two types either mounted or unmounted. Coils specially wound with No. 40 and No. 44 wire on a core of the finest rolled Silicon steel.

SEND FOR RADIO BULLETIN
Prompt Deliveries

JEFFERSON ELECTRIC MFG. COMPANY
424 S. Green St., CHICAGO

PATENTS

To the Man with an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition. Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge. My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense

Booklet of valuable information and form for properly disclosing your idea free on request. Write today.

RICHARD B. OWEN
PATENT LAWYER
2 Owen Building, Washington, D. C.
2276A Woolworth Bldg., New York City

CARDBOARD TUBING

Seamless—Grey	Per Inch or Fraction	Per Ft.
2½, 3 and 3½ in. O. D.	3½c	30c
4, 4½ and 4⅝ in. O. D.	4c	35c
5 in. Outside Diameter	4½c	42c
5½ and 6 in. O. D.	5c	50c

Postage Extra—Shipping Weight, 1 lb. per ft.

Dealers Write for Discounts

MICHIGAN RADIO CO.
2173 Hillger Ave. Detroit, Mich.

No. 987

RADIO CLUB PINS

An emblem made to order for your Club will work wonders—write today for free 52-page catalog, showing Radio emblems, class rings and pins. Samples loaned to officers.

METAL ARTS CO., INC., 7755 South Ave., Rochester, N. Y.

TELEGRAPHY

(Morse and Wireless) and RAILWAY ACCOUNTING taught thoroughly. Big salaries; great opportunities. Oldest, largest school. Endorsed by Telegraph, Railway, Radio, and Government officials. Expenses low—opportunities to earn large portion. Catalog free. DODGE'S INSTITUTE, D Street, Valparaiso, Ind.

A BETTER JOB NOW!

Learn good trade in a few weeks. 10 million autos, trucks and tractors need service. Repairmen needed. FREE 188-p. catalog gives full particulars. Write today.

Michigan State Automobile School, 5342 Auto Bldg., Detroit, Mich.

tions will aid in pacifying the misunderstanding existing at present between we amateurs and the pleasure seeking public.

So fellows, let's band together and fight for our rights as one.

THE WRECK OF A FIFTY-WATTER

One dreary night, Bill Sparks sat down
to pound the key awhile.
He slowly turned the rheostat and fiddled
with a dial.
He thought he'd try to raise some bug
that lived around the state
So he confidently pressed the key, but,
alas! it was too late!
A bluish flame! A little ping!
The bulb was heard to sputter and sing.
Poor Bill arose and began to totter.
Alas! the wreck of a fifty-watter.

5HB Makes Radio History

(*Continued from page* 1472)

perior to borax which is generally used, as the plates are formed quicker and there is no tendency of a scum forming around the plates near the surface of the liquid.

To take care of the 48 jars, one pound of amonium phosphate was purchased from a wholesale drug house and dissolved in two gallons of water.

The preparation of the aluminum and lead strips is a very important thing. In order to succeed in making an efficient electrolytic rectifier it is absolutely necessary to thoroughly clean the plates or strips. To do this—boil them in a strong solution of lye.

The strips used measure 4 inches in length by 1 inch wide. When the strips are properly formed the aluminum should take on a whiteish-gray appearance and the lead should take on a coat of reddish brown.

At the average amateur's station I have found that the rectifier jars which are in the high voltage circuit as well as the plate circuit are very carelessly placed on the floor or anywhere without any thought being given to the proper location.

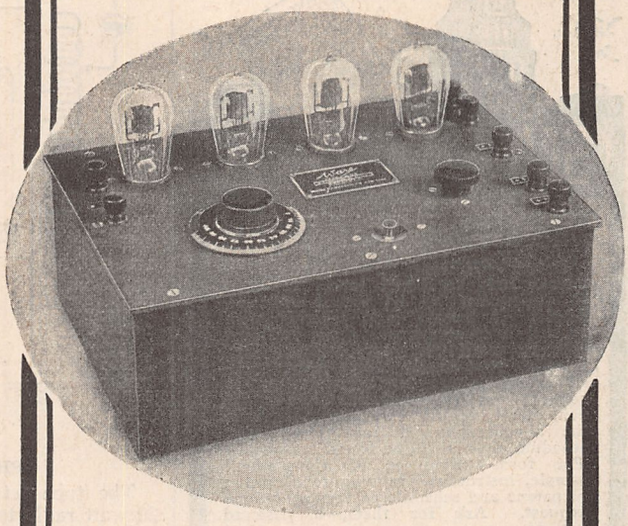
Mr. Bastian has solved this problem very nicely. He has constructed a special chest for his rectifier jars which is provided with a hinged cover. An inspection of his rectifier unit makes one feel like drinking the cool, clean liquid—so clean and neat is the arrangement. This is undoubtedly one of the most important points to consider and if the average amateur would give more attention to the proper installation of his rectifier units there would be more 5HB stations in the country.

The entire chest is properly insulated from the floor!

The keying is done in two ways. The first and the most effective is accomplished by breaking the primary of the plate supply transformer. Another key is placed in series with a 5000 ohm grid leak and is shorted at all times while the other key is being operated. The same thing holds true for the key in the plate supply circuit.

The antenna change-over switch accomplishes a multitude of things. On the receiving side, it puts on the filament current to the receiving tubes—connects the antenna to the receiver—opens the power circuit to the transmitting tubes—and on the transmitting side just the opposite is accomplished.

By throwing over a small single pole double throw switch the spark set is controlled on the transmitting side instead of the C.W. set, the rotary gap operating when the switch is thrown to sending position. All power wiring is done in approved lead cable. The spark set comprises the following parts: ½ k.w. Packard transformer —13,500 volts. Benwood five-point non-synchronous spark gap. Dubilier .004 condenser. Pancake oscillation transformer—1¼" ribbon. A heavy key is used to break the primary of this set.



From 1,000 to 3,000 Miles!

With small loop

This IS the Most Sensitive Receiving Set on the Market and Only $110.00 without tubes

This 3-Step Radio Frequency Amplifier Detector Set WILL:

Operate in any location—steel buildings included.

Reproduce with a tone quality almost unbelievable and positively solve the problem of "static" and other interferences.

Its operation requires no technical knowledge whatsoever.

Send for Descriptive Booklet
Dealers Write for Proposition

Ware

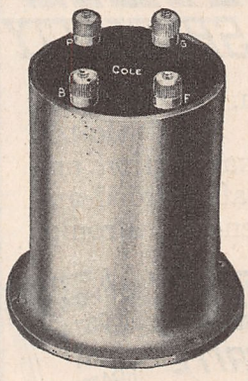
TYPE AD2

R-F AMPLIFIER-DETECTOR

RECEIVER

Ware Radio Corp'n

160-162 Duane Street
New York City, N. Y.



Audio Frequency Transformers

Waterproof— Weatherproof —Breakproof and Foolproof — Absolutely protected.

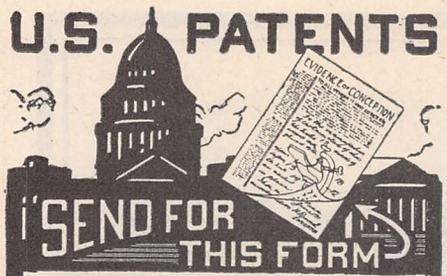
A New COLE Product

THE transformer itself is entirely surrounded with electrical wax inside a hard aluminum case. Moisture, temperature changes, hard knocks, abuse, cannot in the least affect the efficiency of the Cole Transformer. No single resonant point. Equal amplification at all audio frequencies from 200 to 2000 cycles. The best transformer for WD11 Tube. None better for UV 201. Static and other noises eliminated by grounding case.

Write for illustrated circular.

From Your Dealer or Sent Direct to You If Your Dealer Has None on Hand $5.50

A. B. COLE, Inc., 88 E. Kinney St., Newark, N. J.



Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a postcard will do.

LANCASTER & ALLWINE

270 OURAY BLDG., WASHINGTON, D. C.

"Originators of form Evidence of Conception"

PATENTS

C. L. PARKER
Formerly Member Examining Corps, U.S. Patent Office.
PATENT - LAWYER
McGill Bldg., Wash., D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

PATENTS Secured

Prompt service. Avoid dangerous delays. Send for our "Record of Invention" form and Free Book telling How to Obtain a Patent. Send sketch or model for examination. Preliminary advice without charge. Highest References. Write TODAY. J. L. Jackson & Co.....414 Ouray Bldg., Washington, D. C.

OLD MONEY WANTED

$2 to $500 EACH paid for hundreds of old or odd coins. Keep ALL old money, it may be VERY VALUABLE. Send 10 cents for New Ill's COIN VALUE BOOK, size 4x6. Get Posted. We pay Cash. CLARKE COIN CO., Ave. 79, Le Roy, New York

ARE YOU **SELF-CONSCIOUS?**

Embarressed in company, lacking in self-control? Let me tell you how you can overcome these troubles.

M. VERITAS, 1400 Broadway, New York City

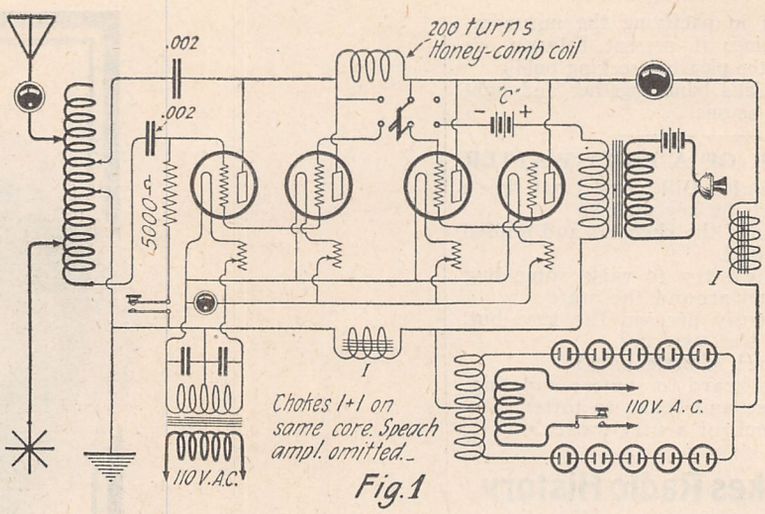


Fig. 1

The Circuit of 5HB's C.W. Set. Provision is Made for the Use of Phone, C.W. or I.C.W.

PHONE CIRCUIT

The tube set is arranged to work as a 20 watt radio telephone set, with four tubes as oscillators, four as modulators and one as a speech amplifier. Nothing has been done on speech work yet and will not be done until more important tasks have been performed—such as the Trans-Atlantic tests.

It is also possible to cut in the eight tubes as oscillators. However, at the present time but four tubes are in use and it is believed they are performing their duty. These tubes are putting out 3.8 amperes.

ANTENNA

There is nothing exceptional about the antenna. It is an ordinary two wire affair sixty feet long, fifty feet high at the lead-in end and thirty feet high at the free-end. It was realized long ago that better results would be obtained by raising the free-end as high or higher than the lead-in end and will be done very shortly.

By raising the free end from 25 feet to its present height (30 feet) signals were reported stronger by practically all the distant stations with whom communication is carried on regularly. As soon as possible the antenna is going to receive very serious consideration—and will be redesigned.

WITH THE ANTENNA AS IT STANDS (on August 18th), TRAFFIC WAS CLEARED WITH AN AMATEUR IN ATLANTA, GEORGIA, AT 3 P. M. (daylight). Two messages were received and one sent. Station worked was 4XF.

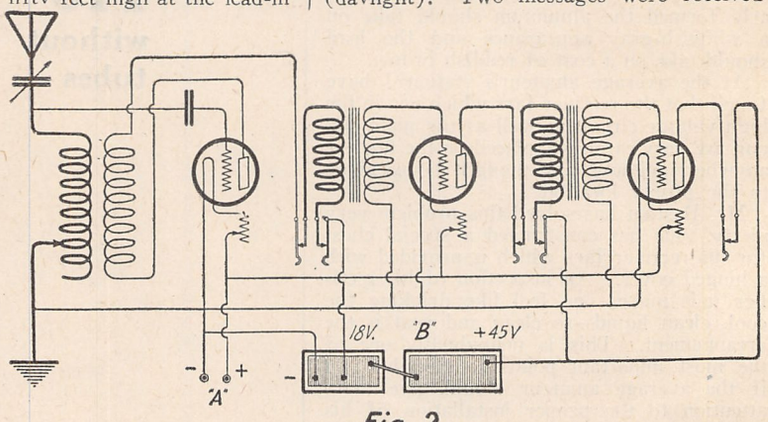


Fig. 2

The Receiving Circuit Used Will Be Recognized as the Conventional Single Circuit Tickler Feed Back Type with a Two-Stage Audio Frequency Amplifier

THE RECEIVER

Super-regenerative? NO! Emphatically NO! Just an ordinary single circuit regenerative receiver with two stages of audio frequency amplification. Mr. Bastian believes in *results* and not experiments. He strives to improve his set but with reasonable plans.

The circuit diagram is given in Fig. 2. Note that there is nothing extraordinary about it.

CONCLUSION

(a) Considering the work that has been done by 5HB with ordinary everyday radio apparatus and with no special attention being paid to the design of the antenna, proves that what work has been done on the apparatus was done in the very best way possible.

(b) That by reaching Seattle, Washington, over-land there is a good possibility of his signals being heard by the British amateurs in the Trans-Atlantic test.

(c) That there is no need for an amateur to send on other wavelengths than 200—that is, not higher than 200.

(d) That there is no excuse for an amateur interfering with broadcasted concerts, lectures, etc.

PATENTS
UNITED STATES & FOREIGN
RADIO & ELECTRICAL CASES A SPECIALTY

Avoid Delays. Profit from Your Invention. Write today for free book "How to Obtain a Patent." **Send Sketch or Model** of your idea for preliminary examination and my report. Your rights will be carefully safeguarded and held in strict confidence. Highest references. Prompt Personal Attention to each case.

CLARENCE A. O'BRIEN
Registered Patent Lawyer
501 Southern Building, Washington, D. C.

FREE
WRITE TODAY

(e) That, if the amateur takes special care in assembling and installing his apparatus, there will be a minimum of interference (locally) (caused by audible blanket over ether), and that maximum efficiency will be obtained.

(f) That the broadcast listeners have a right to contest the amateurs' right to interfere.

(g) That the amateurs have as much right to the ether as anyone else has—but they cannot wantonly interfere with anyone operating above amateur wavelengths.

(h) That the amateurs can and must obey the law, and thereby instill friendship rather than hate in the minds of the novices.

(i) That we need more stations like 5HB o assist the amateur to obtain recognition.

Call	Date	Place	Heard	Worked
1ACU	9/12/22	Groton Long Point, Conn.	X	
1QP	10/25/22	South Manchester, Conn.	X	
1XM	9/12/22	*Cambridge, Mass.*		X
2BJB	4/12/22	*Weehawken, N. J.*		X
2CAB	5/1/22	Bayonne, N. J.		X
3BLJ	6/8/22	Bayonne, N. J.	X	
3IW	5/25/22	Richmond, Va.	X	
3FP	5/11/22	*Clarandon, Va.*		X
3BHM	10/14/22	Trenton, N. J.	X	
2BOI	4/19/22	Washington, D. C.	X	
2CFT	5/11/22	Fort Lee, N. J.	X	
2CEI	10/2/22	Long Branch, N. J.	X	
2CHC	10/18/22	Bronx, N. Y.	X	
2CQZ	10/19/22	Yonkers, N. Y.	X	
2NP	10/26/22	*Elizabeth, N. J.*		X
2AAB	10/12/22	Brooklyn, N. Y.	X	
2CKL	10/19/22	Lakewood, N. J.	X	
3CA	4/9/22	Great Notch, N. J.		X
3QZ	4/12/22	Roanoke, Va.	X	
3BPI	4/20/22	Richmond, Va.	X	
3BPH	4/25/22	Washington, D. C.	X	
3KM	10/16/22	Philadelphia, Pa.	X	
3BGN	10/16/22	Washington, D. C.	X	
3AVA	10/29/22	West Cape May, N. J	X	
4DL	8/20/22	*Philadelphia, Pa.*		X
4LP	4/1/22	Palm Beach, Fla.	X	
5XV	10/19/22	*Shelby, N. C.*		X
5ACF	9/26/22	Port Arthur, Tex.		X
5KC	9/26/22	*Houston, Tex.*		X
5DJ	4/9/22	Plaquemine, La.		X
5JB	4/15/22	Memphis, Tenn.	X	
5MT	4/12/22	*Hot Springs, Ark.*		X
5DO	4/11/22	Loredo, Tex.		X
6KA	10/16/22	*Memphis, Tenn.*		X
7SC	10/20/22	*Los Angeles, Calif.*		X
8BO	5/1/22	*SEATTLE, WASH.* (2,200 miles)		X
8CKO	10/16/22	*Detroit, Mich.*		X
9DGE	10/19/22	*Pittsburgh, Pa.*		X
9AYS	10/18/22	*Minneapolis, Minn.*		X
9DCT	10/1/22	*Lincoln, Neb.*		X
9BRS	10/20/22	*Appleton, Wis.*		X
9EI	8/19/22	*Des Moines, Ia.*		X
WSB	4/10/22	*Lexington, Ky.*		X
5JB	10/15/22	*Atlanta Journal Station, Atlanta, Ga.*		X
4XF	10/18/22	Hot Springs, Ark. 5:15 P. M. Atlanta, Ga. 3:00 P. M.		

Constructive Criticism on Phone Design

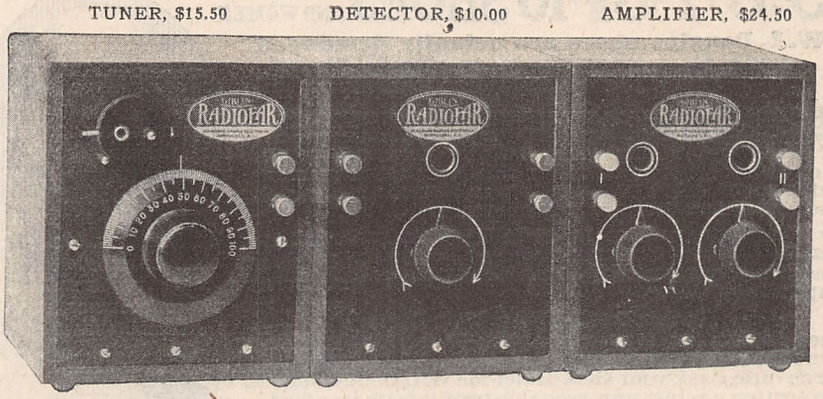
(*Continued from page* 1464)

through this pulsating current, must needs distort the voice in the transformations, as a certain movement of the diaphragm, while producing a movement more or less corresponding in point of time, corresponds but little in point of proportional strength, the magnetic fields in each of the two instruments, not being symmetrical, when normal, nor when the electro-magnets superimpose their respective fields, as during speech, any variation in either field, from any cause, would not be accompanied by a variation in the current proportional to the magnitude of the cause. Hence, distortion and deletion of finer, minor vibrations are caused by this defect alone.

The writer has dwelled at length on the shortcomings of this obsolete phone, because of all the receivers magnetically operated, this type more nearly resembles the modern headsets when actuated by minute radio current. Many causes of distortions and deletions are traceable to similar faults in design. A receiver which functions well on battery line phones, or even on radio code work requiring but a

THE NEW GIBLIN RECEIVER, DETECTOR AND 2-STAGE AMPLIFIER

TUNER, $15.50 DETECTOR, $10.00 AMPLIFIER, $24.50



$50 COMPLETE

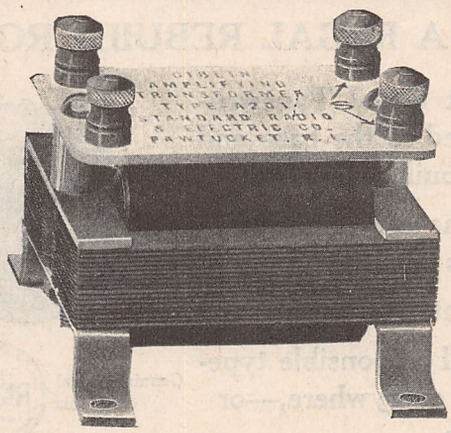
A GENUINE PERFORMER

INCORPORATING

SINGLE CONTROL TUNER—It is easily and quickly tuned with full efficiency on any wave-length.
DETECTOR—Receives either local or distant stations with perfect clearness.
AMPLIFIER—2 stages with separate filament control, securing maximum volume without distortion.

Are YOU From Missouri?

MOUNTED $4.50



UNMOUNTED $3.50

In one month this Transformer has received approval from Maine to California

THEN TRY THIS

GIBLIN Audio-Frequency AMPLIFYING TRANSFORMER

Designed for use with standard amplifying tubes.
Maximum amplification without noise or distortion.
May be placed in any position without pre-magnetic coupling and squealing.

LIBERAL DISCOUNT TO DEALERS

STANDARD RADIO & ELECTRIC CO.

PAWTUCKET, R. I.

DUCK - Radio Pioneer

Announces Startling Reductions

The Leading Line Since 1909

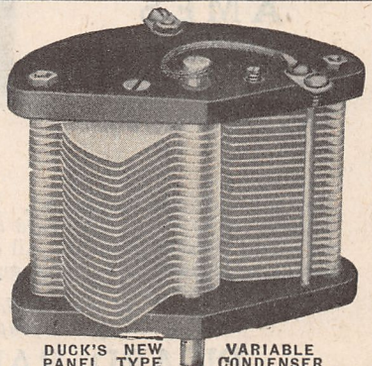
At Prices to You Less Than Dealers' Cost

FREE Illustrated pamphlet comprising sixty-two Duck radio instruments and sets with reductions averaging 30% mailed on request. Send postal today. Any old time radio amateur will tell you who we are and our reputation. Only a few years ago almost one-third of the radio instruments sold at retail, exclusive of sales in only a half dozen large cities, were sold by Duck.

A Few of the Many Duck Products at Startling Prices:
Rheostat, 70c; Bakelite Moulded Positive contact, 70c; Bakelite Moulded dial, 55c; superselective moulded variometer, $4.65, worth $8.00; radio frequency potentiometer, $1.15; solid mahogany form variometer, $3.60; 43-plate panel-type variable condenser, pigtail connection, $3.15; detector panel, $5.25; receiving set, mahogany cabinet, detector and two stages of audio frequency, $59.50; radio frequency receiving set with one-step radio and detector, $29.75.

Send 25 Cents in coin or money order for our big 256 pp. combined Radio Catalog and Text Book. For radio information and hook-ups it is worth many times the retainer asked.

THE WILLIAM B. DUCK COMPANY
231-233 Superior St., Toledo, Ohio



DUCK'S NEW PANEL TYPE VARIABLE CONDENSER acclaimed by all that have seen it to be the peer of any on the market. Pigtail connections, i. e., no sliding contacts. Base and top moulded bakelite. Aluminum separators, i. e., even spacing and simple means of adjusting plates. Mounting screws furnished. Concealed by dial. Brass bearings; ¼" shaft.

W. L. DOUGLAS

$5 $6 $7 $8 & $10 SHOES FOR MEN AND WOMEN

W. L. Douglas shoes are actually demanded year after year by more people than any other shoe in the world

BECAUSE W. L. Douglas has been making surpassingly good shoes for forty-six years. This experience of nearly half a century in making shoes suitable for Men and Women in all walks of life should mean something to you when you need shoes and are looking for the best shoe values for your money.

W. L. DOUGLAS shoes in style, quality, material and workmanship are better than ever before; only by examining them can you appreciate their superior qualities.

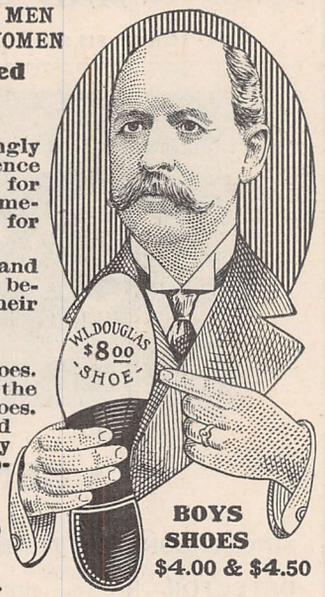
No Matter Where You Live

shoe dealers can supply you with W. L. Douglas shoes. If not convenient to call at one of our 110 stores in the large cities, ask your shoe dealer for W. L. Douglas shoes. Protection against unreasonable profits is guaranteed by the name and price stamped on the sole of every pair before the shoes leave the factory. Refuse substitutes. The prices are the same everywhere.

If not for sale in your vicinity, write for catalog.

TO MERCHANTS: If no dealer in your town handles W. L. Douglas shoes, write today for exclusive rights to handle this quick selling, quick turn-over line.

W. L. Douglas
President
W. L. Douglas Shoe Co.
172 Spark St. Brockton, Mass.



BOYS SHOES
$4.00 & $4.50

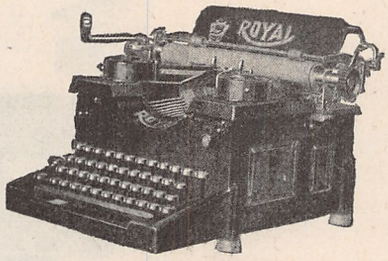
BROADCAST YOUR BUSINESS MESSAGES ON A REGAL REBUILT ROYAL

Regal Rebuilt Royal Typewriters are stripped to the base and thoroughly rebuilt by experts.

They carry the same kind of a guarantee as a new typewriter.

Cash or monthly payments.

For sale by all responsible typewriter dealers everywhere,—or Write direct to

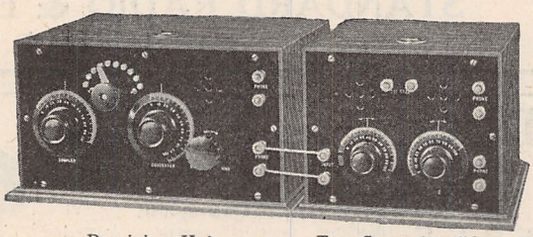


Genuine Regal carry this "LIKE-NU" REGAL REBUILT TYPEWRITERS trade-mark. Rebuilt Royals

REGAL TYPEWRITER COMPANY, INC.,
359 Broadway, New York, N. Y.
Marcus Harwitz - - - General Manager

AMES *Receiver*
AMES *Amplifier*

Sold separately or in combination



Receiving Unit $40.00
Two Stage Amplifier $35.00

Honestly built—not assembled. Non-regenerative, guaranteeing ease in tuning. Stations 500 to 1000 miles heard constantly. Genuine XX Bakelite Dilecto Panels, mahogany finished cabinets. All connections in rear of cabinets. Appearance and quality unequaled. Absolutely guaranteed—money refunded if not satisfactory.

If your Dealer can't supply you, write us.
Special proposition to reliable Dealers.

PICARD RADIO CORPORATION
Wholesale Distributors
18 West 46th Street, New York

monotonous response, may distort miserably as a radiophone receiver, regardless of the ohmage wound on the electro-magnets.

We are using the puny radio currents in magnetic receivers to upset the balance between comparatively enormous magnetic pull of the permanent magnets toward the diaphragm-armature, and the elastic resistance inherent in the *stiffness,* resulting from the thickness of the diaphragm; in other words, the radio current is "the straw that breaks the camel's back."

Do not let us lose sight of the fact, that no matter what the magnitude of the forces whose balance we are thus juggling, *ALL* the energy which is converted into sound waves, and *several thousand per cent.* more, which is wasted, or worse, is derived solely from the radio impulses, and that there is of necessity an enormous loss suffered by this radio current in overcoming the excessive inertia inseparable from excessive masses and forces, inertia, mechanical, electrical, and magnetic, by whatever technical names we may call them.

VALUE OF RADIO CURRENTS

We are dealing with forces which are comparable to 1/1200 part of a millionth of an ampere, and up to 3 or 4 milliamperes after many amplifications. Values averaging the energy expended by a medium-sized bacillus in wriggling his left ear, and in sneezing, respectively (if they do such things), and its hardly politic to set it to fluxing a sheet of iron or silicon steel often as thick as 1/100 part of an inch, and 2½ to 3 inches in diameter. Even a linear displacement at the center of 1/10,000,000″ which is nevertheless audible under certain circumstances, requires substantial energy to control, very much more than to produce it. Clearly, the continuation of line phone proportions, principles, and inertias in radiophones is a mistake. The writer will endeavor to suggest changes in the conventional Bell receiver, some of which may at first appear to afford but microscopic advantages, used as we are in our subconscious mind to judge things and their effects by "man-size" standard. Nevertheless the incorporation of them all, and judicially balanced in design, is bound to increase the utility and efficiency of this type of receiver several hundred per cent.

DEPEW'S FOURTEEN POINTS

1. Diaphragms of white silk, varnished, or certain papers, skins, celluloids, elastic by reason of being mounted on a separate ring, on which they are stretched out and clamped, rather than by reason of being rigid owing to temper and thickness. Result—same or more spring action, with a fraction of the inertia of semi-rigid diaphragms.

2. Armatures of transformer (silicon) steel annealed for 100 hours, to minimize hysteresis loss, mounted in center of diaphragm, separated by a disk of parchment tissue, onion skin or paper of a diameter ¼ smaller than the armature.

3. Armature to be .012″ to .015″ thick, or thick enough to respond instantly to fluctuations in the electro-magnetic flux, superimposed upon the permanent magnetic flux without saturation anywhere, having sufficient section.

4. Armature to be light by reason of its small diameter, it requires to extend but 1/16″ beyond the outermost layer of windings catching and carrying the entire coil pull, mostly directly through its section, diameters to vary between the sizes of a 5 and a 10 cent piece.

5. Clearance between the top of the diaphragm and the inside of cap to be .0005″ at the clamping edge, arching to .002″ at the center. By reducing the clearance to the practical limit we get a much greater proportional variation in air pressure as well as improving air damping and "stopping

flutters from starting." A very important point—the average cover now has 1/16" straight clearance—a volume 20 to 50 *times* too large for efficiency and center hole 25 to 40 times too large, 2000 per cent to 5000 per cent.

6. If phone is to be used directly against the ear, six small holes placed in a hexagon around the center are much better than one big hole. They should have a bore of 1/16" to 3/32" only, depending on diameter of diaphragm, the hexagon should be ¼ to 1/5 of the diameter of the free, vibrating portion of the diaphragm.

7. The small holes should be countersunk 60° of arc from both sides to a diameter ⅛", cover to be thick enough to prevent countersinkings from meeting in the center, and enlarging holes. This shape, along with the improved clearance enables the diaphragm to cause an "explosive" puff in the venturi-shaped holes even from the minutest displacements, similar somewhat to the sound we make with our lips in pronouncing the letter "P." Faithful adherence to the above proportions will sharpen the enunciations, hence the sensitiveness, and audibility, *without a trace of a whistling effect* in the loudest

8. Black composition caps and metal diaphragms could well be replaced by white caps and "warm" diaphragms, if for no other reason, than to conserve the thermal status of the air. At each compression phase of the sound wave, sensible heat is evolved and at the next phase, the one of rarefaction, there is a corresponding drop in temperature; both the raise and the drop tend to increase the change in volume for a given displacement, hence increasing the audibility by so much.

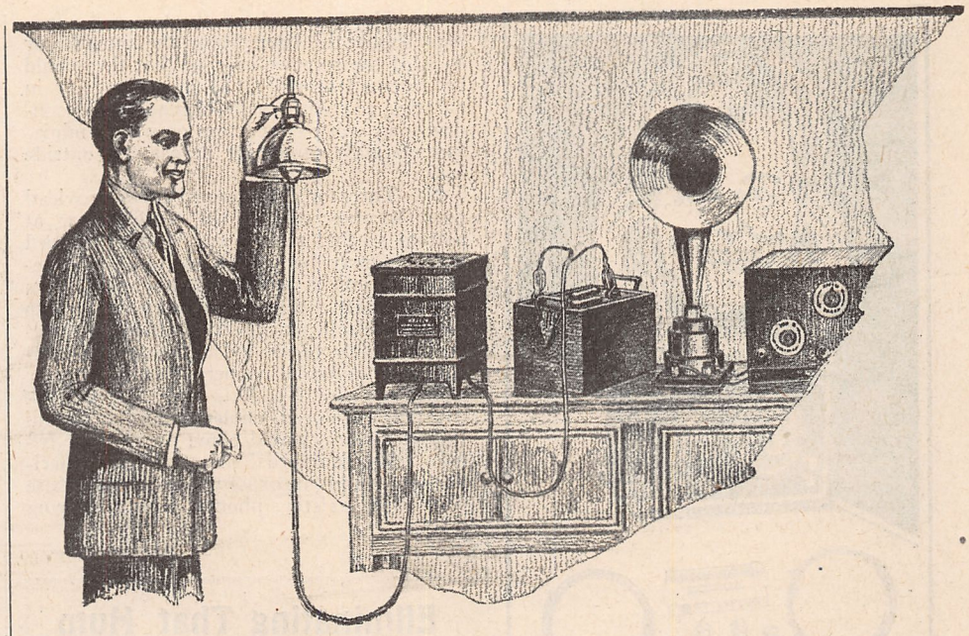
Black caps and metal diaphragms enter into an instantaneous interchange of heat with the wave, absorbing part of the increase, and supplying part of the deficiency, and in unequal degrees, thus diminishing the net difference between the two phases, and partly distorting to both, "getting them going and coming." White and warm substances reflect or convect 80 per cent to 90 per cent of the heat, minimizing interchanges.

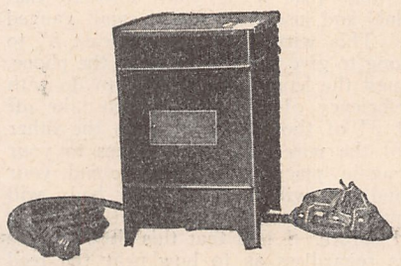
9. The efficiency of a receiver can be doubled by merely utilizing the fact that each diaphragm has at least *two* healthy, working sides, both fluttering in the air simultaneously, by suitably attaching two tubes like a physician's stethoscope, each tube to connect one chamber, that is, a side of the diaphragm to one ear.

10. By filling the magnet chamber with paraffin or similar insulating substance, to make it even with the top of the pole pieces, covering with white celluloid or paper stuck to the paraffin, with a bent tube open at a level with the top paper, imbedded in the filling, we approximate the same acoustic thermal and mechanical conditions obtaining on the top, or "conventional" side. We not only get an extra phone, but one of "matched sound," which feature is well known to increase audibility, irrespective of all other refinements.

11. While the diaphragm should have a fixed clearance from the cap, the entire assembly of stretched diaphragm, non-magnetic stretch-ring, clamp, lock-ring and cap, all together should be adjustable within limits, with respect to the pole pieces.

12. That part of the cap which touches the ear should be seperate, and easily removable to be replaced at will either by a sponge rubber pad with holes to register with the sound holes, or by a cap with tube attached to utilize the "stereoscopic" feature of point 9 more conveniently as the receiver can then be either worn on the chest, under the chin, or left on the table, the tubes leading to the ears.





Tungar
BATTERY CHARGER

The device that keeps batteries at home

Charging Storage Batteries Easy as Turning on the Light

Tube sets require storage batteries, and they in turn require charging. You can do this at home merely by turning on the electricity, if you have a Tungar Battery Charger.

Tungar is a device for changing alternating to direct current. It allows the current to flow only in one direction. It requires no attention while operating. Its first cost is not high and its cost of operation is extremely low.

Tungar Battery Chargers were developed in the Research Laboratory of the General Electric Company over six years ago. Thousands have been in successful operation ever since.

Do you prefer to carry your battery to a charging station, wait a couple of days or more, and then pay three times what it would cost you to charge it at home? Our new booklet on the application of Tungars to radio batteries will give you the details. Ask us for Booklet B-3640, if your dealer cannot give you one. Address Merchandise Dept., General Electric Company, Bridgeport, Conn.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

35A-76

MPM

MILLION POINT MINERAL

The World's Greatest Radio Crystal

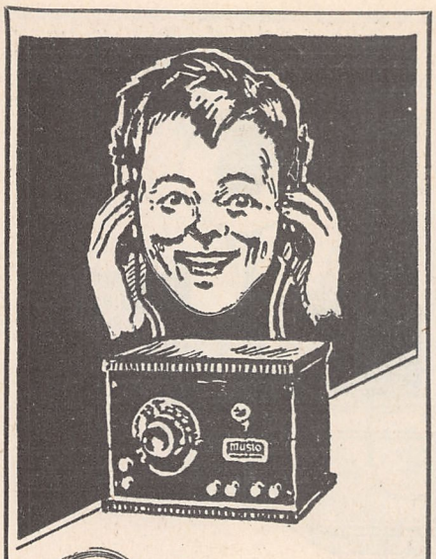
M. P. M. is supersensitive, reproduces from every point on its surface and has record of receiving concerts over six hundred miles.

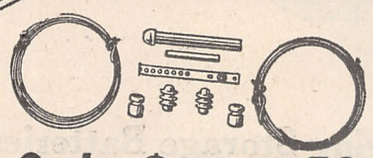
Ask your dealer for M. P. M or send 25c for one M. P. M. Crystal, concert-tested and guaranteed

M. P. M. SALES COMPANY

Dept. N. 247 So. Central Los Angeles, Cal.

Get a Handy Binder for your RADIO NEWS. Holds and preserves six issues, each of which can be inserted or removed at will. Price 65c. Experimenter Pub. Co., Inc., Book Dept., 53 Park Place, New York.





Only $12.50

($15.75 with Ear Phones)

Think of it, a complete receiving set for only $12.50. Its Musio—radio's latest development. Musio comes complete with copperweld antenna, ground wire, insulators, knobs and clamp—all ready to connect up. This outfit contains Musio's Remarkable Crystal Detector. Send now for full facts about this wonderful receiving set and get this unusual offer. Also get our Jewelry Catalog. Yes—

DIAMOND BARGAINS too—

See the many big amazing values—some as low as $60 per Carat, other higher per Carat bargains. This 75 year, oldest, largest Diamond Banking firm in all the world, lends money on diamonds. Thousands of unpaid loans and other bargains. Must sell NOW.

Why Pay Full Prices

Costs Nothing To See

Any diamond sent for absolutely free examination at our risk. No obligation.

Latest Listings *Unpaid Loans*

Sent Free

Unlike the ordinary catalog. Hundreds of Diamond Bargains described in full detail with exact weight, color, quality, etc. You know what you're buying before you buy. Besides it *tells of Guaranteed Loan Value* unlimited exchange privilege at full price paid, and complete details of free examination offer.

Use Coupon Now

Bargain List Free

Jos. De Roy & Sons
4695 DeRoy Bldg.
Only Opp. Post Office
Pittsburgh, Pa

Gentlemen: Please send me free and prepaid, your latest bargain list of diamonds, watches and other jewelry. Also complete facts about your $12.50 radio set. It is understood I assume no obligation of any kind.

Name .....

Address .....

Guaranteed Cash Loan!

Diamonds bought here are like insurance policies. You know what you can borrow before you decide to buy—SEE OUR CASH BACK GUARANTEE.

Jos. De Roy & Sons
4695 De Roy Bldg.
Only Opp. Post Office
Pittsburgh, Pa.

References by permission: —Bank of Pittsburgh—N.A. Marine Nat'l Bank—Union Trust Co. Pittsburgh, Pa. Your bank can look us up in mercantile agencies.

You can be quickly cured, if you

STAMMER

Send 10 cents for 288-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering 20 yrs. B. N. Bogue, 883 Bogue Bldg., 1147 N. Ill. St., Indianapolis.

13. The four ends of the two coil windings should be brought to the outside, or back of the receiver case, so that they could be switched at will; (1) in series, (2) in parallel, (3) with easily changed fixed condenser in either connection or with a miniature variable condenser across the outside leads.

14. Three or four tapped holes provided near the outer edge of the receiver case, at bottom so that one or two extra C-shaped magnets may be quickly added to or removed from the outside. Brass spring clips might be fastened to the tapped holes to snap the magnets in place. A receiver conforming to the above, wound to the proper ohmage, with annealed copper or silver wire or ribbon; if wire, No. 40 to No. 42, single silk covered, uncolored, unbleached, of a certain Italian quality, would come pretty near being "fully equipped." Any adroit experimenter could incorporate most of these points into existing phones, with gratifying results.

Eliminating That Hum from the Light Current

(*Continued on page* 1480)

small bolt that holds your cord to that terminal and insert a piece of small gauged wire. This wire should be at least 8″ to 10″ long to give plenty of play to the phone, although the length has nothing to do with the efficiency of the plan. Then take off about 3″ of the insulation from the other end of the wire. Put the phones to your ears again placing the wire behind your ear and you will find that your body will eliminate the undesirable sound that you heard before. I find that this little scheme works regardless as to how near the feed wire might be. I have had my antenna as close as one inch and running parallel to the light wires and I could not hear the slightest hum in my receivers.

Keeping the Public Sold on Radio

(*Continued on page* 1444)

tances is all right, for him. He may be unreasonable, though few of them are, about wanting to QRT everybody else while he tries over and over again to put across a message of no more importance, as a message, than a street car conductor's remarks about a pair of striped stockings, but he has a real objective and he pushes toward it with fine persistence. On the other hand I believe that he has killed a lot of trade in home radio outfits by getting himself into a job as a salesman—a job that he hates if he is a real technical man—and then trying to put over his ideas on folks who don't know even yet just what he was talking about.

For example, the single circuit tuner has been a special point of attack for the technical amateur. Naturally. It turns his well-regulated transmitting wave into a constant source of annoyance to listeners-in around his neighborhood. It lets loose flocks of "canary birds," if it is of the regenerative type, and they drown out the weak signals from afar that he is straining his ears to catch. How can he go to work at eight in the morning, after sitting up until two or three o'clock in order to get a chance to clear his traffic, and sell the low-priced, simple sets that the public asks for but that

Dr. T. O'Conor Sloane Will Teach You CHEMISTRY Right In Your Own Home

DR. T. O'CONOR SLOANE, A. B., A.M., LL.D., Ph. D., Educational Director Chemical Institute of New York, formerly Treasurer American Chemical Society and a Practical Commercial chemist as well as a noted instructor.

Good chemists command high salaries. Industrial firms of all kinds pay tempting salaries to get the right men. Salaries of $10,000 a year are not unusual for chemists of exceptional abilities. The work of the chemist is extremely interesting. If you are fond of experimenting, take up chemistry. If you want to earn more money, the way is open through our Course in Chemistry.

You Can Learn at Home

Dr. Sloane will teach you Chemistry at home in a practical, intensely interesting way. Our Course is remarkably simple. No special education required—if you can read and write plain English you can thoroughly understand and master every lesson.

Easy Monthly Payments

The price of our course is very low and the tuition includes everything, even the chemistry outfit—there are no extras to buy with our course. You can pay in small monthly amounts as you go along. Our plan places a chemical education within the reach of everyone.

Experimental Equipment Given to Every Student

One special feature of our course is that we give to every student, without additional charge, the chemical equipment he will need for his studies, including forty-two pieces of laboratory apparatus and eighteen different chemicals and reagents. The fitted, heavy wooden box serves as a carrying case for the equipment and as a laboratory accessory for performing experiments.

SPECIAL 30-DAY OFFER

In addition we are making a special offer for a short time only. You owe it to yourself to find out about it. Mail the Coupon to-day for free book, "Opportunities for Chemists," and full details of our special offer. Act immediately before this offer is withdrawn.

—CUT HERE—

CHEMICAL INSTITUTE OF NEW YORK, Inc.
(Home Ext. Division, 2-A, 140-R, Liberty St., N. Y. City

Without obligation or cost, send me your free book, "Opportunity for Chemists," and full particulars about the Experimental Equipment given to every student, and tell me about your plan of payment and special 30-day offer.

Name .....

Address .....

City ..... State .....

LEARN ELECTRICITY IN 3 MONTHS

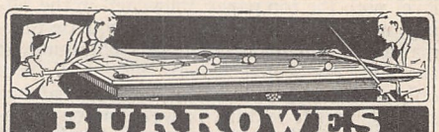
IN THE GREAT SHOPS OF

Make this the most profitable and enjoyable summer of your life. Come to Chicago, the electrical center and the country's greatest summer resort city. Learn Electricity in America's oldest, largest and best equipped school. Earn your way, free employment dept.

FREE R. R. FARE If you come now we will pay your railroad fare and give you *free* a course in auto truck and tractor electricity, a course in radio, and a life scholarship in the great Coyne School. This is the greatest offer ever made by a school. Write at once for particulars as we cannot keep this offer open long.

Write Today **Coyne**

Trade and Engineering Schools
1300-1310 W. Harrison St.,
Dept. 5942 Chicago, Ill.



BURROWES

Home Billiard & Pool Tables

Magnificently made in all sizes, at all prices. Game exactly same as standard table. Become expert at home. Use in any room, on any house table or on its own folding stand. Quickly leveled. Put up or down in a minute. Full playing equipment free. Small amount down, small payments for a few months. Ask your dealer or WRITE us TODAY for Catalog.
E. T. BURROWES CO., 103 Free St., Portland, Me.

ELECTRICAL Training Book FREE

Send me your name and address and I will send you my big new Electrical Training Book Free. It will show you how to qualify for high paying jobs in Electricity. Thousands now open. Prepare at home—quickly—during spare time under an Electrical Engineer. Take advantage of this unusual offer—only temporary.

A. W. WICKS, President WICKS ELECTRICAL INSTITUTE
Dept. 1077 3601 Michigan Ave. CHICAGO

are the cause of most of his trouble? How can he interest himself in connecting them up and teaching his prospects their radio ABC's? I find them everywhere, these technical amateurs, fighting their jobs. One was trying to bring in the World's Series from New York with a super-regenerative receiver, in the crowded aisle of a busy store hundreds of miles away! He was attempting to get it loud enough for a crowd on the street to hear. The crowd had evidently been promised, in ads in the papers, that the store would give the game play by play.

The radio man was not getting the game, neither was the crowd. He explained interestingly to those near him what the trouble probably was, and how the super set differed from the others, but the crowd wanted to know who was pitching, who was hitting, what the score was.

At the same time a local station was broadcasting the game, probably not more than a minute behind the New York station if indeed there was any difference. Eventually the operator tuned in the local station and the horn over the door sung out the details of the game so that they could be heard anywhere in the block. He turned away with a disgusted air, snapped at a customer who made some innocent request and retired to cool off. To him it was a flat failure though to the crowd it spelled success.

It is hardly fair to blame the operator-salesman. Very likely the store manager had offered him strong inducements to get him away from more congenial pursuits. It seems to me that an executive who will pick a laboratory type of man and put him behind a counter has a screw loose somewhere. He deserves what followed. A score or more of people went away making mental notes of the super-regenerative receiver as something to be avoided.

Many of the best radio salesmen are those who sell radio unconsciously and without compensation. In Connecticut there is a headquarters of a national organization in charge of a president who is one of the best advertisers in the country. I mean by that that he advertises anything that pleases him. In his official organ he comes out with point blank broadsides in favor of anybody from the local grocer to the President of the United States if he thinks they have done something deserving of special notice. He goes around the country lecturing and is never afraid to recommend what he has found to be good. He also entertains many visitors, showing and explaining the apparatus that he uses.

He has seven laboratories in which he does scientific work, so he is naturally interested in a subject like radio. In spite of this he has but just discovered radio. A neighbor gave him a set. Here is a part of what he said in his official organ:

"We are delighted with a new radio outfit . . . We are especially pleased with the kind thoughtfulness that prompted this gift. Unlike many others it was not solicited or even suggested and, to be frank, through a misunderstanding and the influence of incorrect information, previous to using this outfit we, and probably others in these early days of the radio, did not even desire one. In fact we believed that such an apparatus would be objectionable. These previously held, erroneous notions convince us that many dealers in radio supplies are not making an advantageous impression for their goods. Radios that I and my assistants had heard screeched, squawked and yelled in a disagreeable and exasperating manner. Little did we suppose that a radio could present in our welcome Reception Room music almost as clear as if originally produced there, and that conversation from Philadelphia or Schenectady could be heard as clearly as was the voice of the generous donor over the telephone in offering the gift.

"Our preconceived, incorrect notions of

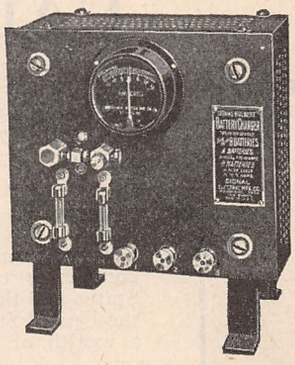
(That's wireless for "Attention!")

LISTEN IN, everybody. This message is for *you*. Radio promises more than ever for the coming season. Are you going to get your share of the fun, the entertainment, the culture, and the many other advantages Radio now offers?

Then it's time to think of Radio equipment. When buying Radio parts or sets ask these questions?

Who Builds It? Who Uses It?

SIGNAL



If it's SIGNAL equipment you'll find that it was produced by a plant and an organization whose experience in making small electrical goods goes back over a period of 35 years—that it grew up with "wireless"—that men there have grown gray in their service and take old-time pride in seeing that nothing but the best in materials, workmanship, and finish leaves the SIGNAL plant.

And you'll find that it is used largely for commercial purposes, by the army and navy, by the professionals in Radio, as well as by the semi-professionals and the amateurs—most successfully and most satisfactorily.

Buy SIGNAL Radio Parts or Sets and you will buy Radio Service and Radio Satisfaction.

SIGNAL—Hulbert Battery Charger

Charge 2 batteries in your home at the same time for 5c—from any 110 volt A. C. lighting socket.

Send for our Booklet and Special Bulletins—use coupon below if you wish.

(2054)

SIGNAL Electric Mfg. Co.

Factory and General Offices:

1912 Broadway, Menominee, Mich.

Atlanta Boston Chicago Cleveland Minneapolis
Montreal Pittsburgh San Francisco St. Louis Toronto

You'll find our local address in your Telephone Directory.

Coupon for guide to Radio Satisfaction.

Signal Electric Mfg. Co.,
1912 Broadway, Menominee, Mich.

Please send, without obligation, your interesting book about SIGNAL Parts and Sets, to the name and address written on the margin of this page.

.....

.....

.....

Spirola TRADE MARK **BETTER LOUD SPEAKERS**

AT HALF THE USUAL PRICE

Real Cabinet Type—Not Just a Common Horn Built Into a Cabinet

Beautiful—Compact—*A tone comparable only to the finest cabinet phonographs*

We make a complete line—of the highest class construction throughout, with fine hand-rubbed finishes. All SPIROLAS are sold under moneyback guarantee to equal in volume and far surpass in beauty and tone any other up to twice their price.

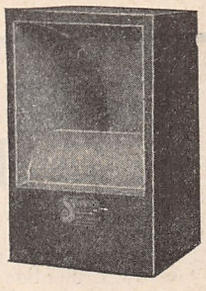
SPIROLA DUPLEX—for use with any headset. Improved type with separate tone chamber for each phone, eliminating usual interference between phones. Satin black finish with nickeled fittings (Model DB).... **$3.85**

Oak (DO) or mahogany (DM) finish, bronzed throat and fittings.....$4.85

SPIROLA SIMPLEX—for use with Baldwin or other unit. Black (SB), oak (SO) or mahogany (SM) finish, same prices as DUPLEX.

SPIROLA CONCERT—complete with built-in special unit and cord ready to attach in place of phones. Oak (CO) or mahogany (CM) finish, bronzed throat $12.50

At Dealers or postpaid, carefully packed (C.O.D. if preferred).



L. H. DONNELL MFG. CO., DEPT. A, BOX 70, ANN ARBOR, MICH.

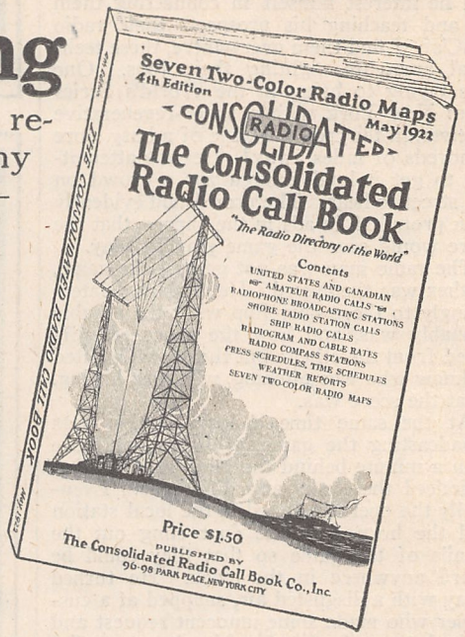
FREE

Complete price list of radio parts.
Write Aitken Radio Co.,
412 Superior St., Toledo, Ohio.

RADIO AGENTS wanted in every town to sell Ames products. We manufacture long distance Radio receiving sets and parts. Write for plan. Picard Radio Corp., Dept. N, 16 W. 46th St., New York.

Know Who Is Sending

Get twice the pleasure and usefulness out of your receiving set. Look up the name and location of any ship or land station whose messages you pick up—learn the name and address of that amateur whose sending set you just heard.



4th EDITION OF THE CONSOLIDATED RADIO CALL BOOK

In a new large size — 280 pages — 88 more valuable pages than the 3rd Edition and featuring

7 Two-Color Radio Maps

Five of them are Continental Maps showing all stations throughout the world handling commercial traffic, with their calls; one showing the amateur radio districts of the United States and the principal radiophone broadcasting stations with their calls; and a map of the United States Weather Forecast Zones. Seven wonderful, two-color radio maps with a wealth of information that will give you a great deal of pleasure and knowledge.

Every Amateur Call in the U. S. and Canada is Listed Besides Other Valuable Information Contained in This New Book

All Amateur Radio Calls of the United States and Canada; Every Vessel, Coast Station, and Radio-Compass Station in the World; Radiophone Broadcasting Stations of the United States; Every High-Power Station in the World, Special Land Stations of the United States; Time Signals. Hydrographic and Weather Reports of the United States and Principal Foreign Countries, International Abbreviations; Assignment of International Calls; Press Schedules; Radiogram Rates; Cable Rates; International Morse Code and Continental Signals; and Complete General Information covering Distress Calls, International Safety Signal, Use of 800-Meter Wave Length, Amendments and Changes in Various Government Regulations. How to Determine Charges on Radiograms, Free Medical Advice by Radio to Vessels, and much other useful information.

$1.50
Prepaid

And every vessel and land station in the world is represented and listed alphabetically, according both as to name of vessel or land station, and to letters. The Consolidated Radio Call Book is the only book in print officially listing all the Radio calls as issued by the Bureau of Commerce. And the New Radiophone Broadcast Section is particularly complete and gives all available information concerning calls, wave lengths, PROGRAMS, etc.

The third edition of 10,000 copies was exhausted in two weeks. The fourth edition is selling just as quickly. Don't wait until it is all gone. Order at once, either direct from us or from your favorite dealer.

Published by

Consolidated Radio Call Book Co., Inc.

96-98 Park Place, New York City

Great 40-Page Supplement FREE to all who have the 4th Edition Call Book

As a special service to the readers of the Fourth Edition of the Radio Call Book, we have printed, at great expense, a 40-page supplement containing the latest amateur radio calls of both the United States and Canada, and other calls issued very recently. It is absolutely free to all those who write for it, provided you have bought a copy of the fourth edition of the Consolidated Radio Call Book. This wonderful supplement brings the call book up to the very last moment and on account of the many changes that have taken place and which are fully covered by this supplement, every radio amateur or professional is urged to send for his free copy of this supplement today.

Send to us direct or get it from the dealer from whom you bought the 4th Edition Call Book.

the radio have vanished. It may be unusual to exploit errors and mistakes, but we do it for the benefit of others who may have heard from the sidewalk in front of some radio store sounds that reminded them of butchering pig day on the old farm or made them think that fire whistles and bells, falling tin pans and other bedlam had gotten into an awful confusion.

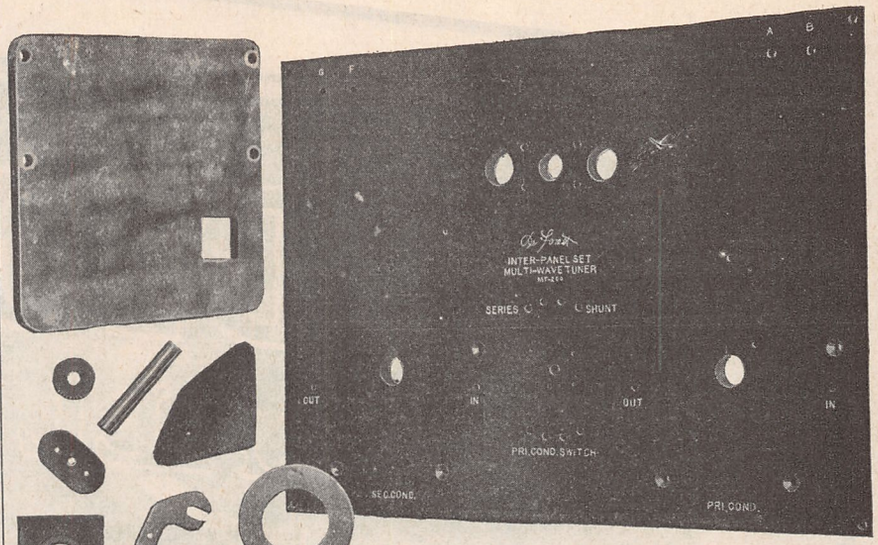
"Commercial enterprise should describe the real delight of a radio and tell us what I have never heard mentioned personally or ever seen in print—that the horrible noises heard from some radios are only occasional."

There followed column after column of appreciation, with pictures of local stations and accounts of the experiences of their operators.

It was suggested in Radio News more than a year ago that editors were among the first who should be made acquainted with radio. It would seem that common sense would lead radio interests, national and local, to make sure that every editor was set on the right track. Yet not infrequently I find one who has never yet heard anything interesting by radio,—heard it so well that he could even forget for the time that radio was the means of communication used. It seems hard for the radio man to realize that the average man, though he be an editor, has only a passing interest in the apparatus used in communication. The average woman has no interest whatever in the apparatus and women do most of the family spending. It is folly to talk tubes and variometers and grid leaks to such folks. The telephone man does not approach the householder with a switchboard and a battery. He tells him and shows him what the telephone will do. Not until the purchaser can use his apparatus for a purpose and forget all about its complexity will radio be really sold to the public. To try to sell it on the basis of technical amateur interest is to narrow the field down to less than ten per cent of what it really is.

At the present stage of the game the problem as I see it from the standpoint of us radio users, the "novices" whom the technical amateur often views with such deep disgust, but who will always be "novices" for the reason that we are not technically minded and are not trying to recast our lives in his mold, is to give the radio public some real demonstrations. Not such as I saw in an up-state New York city, where a dealer with a store full of invited guests, influential-looking people, let one amateur after another try his hand at a set that none of them could work. I waited an hour and a half to hear what they would bring in. All they brought in was their own sets that they scurried home to get in order to help the dealer out, and the affair ended up in an enthusiastic conference of radio amateurs while the prospective customers went away with their money still in their pockets. Again it was the dealer's fault. Any one of the amateurs could have been employed no doubt to set up an outfit and make it work. With proper instruction and supervision he might have been made to see that the object was to sell goods to non-technical customers and that what was needed was a demonstration, not a series of technical experiments with the customers looking on.

Of course the conditions last winter were enough to turn the head of even a conservative dealer. After the first rush the manufacturer did not want any more orders and, as he could not get anything to sell, the retailer was not anxious to get more customers. The more anxious the would-be purchaser was the more coldly he was turned down, unless, as in some New York stores, he could get an advantage over other customers by paying a bonus. (I wonder how these "bonus" houses would like to have their names published at this stage of the



Permanent Dielectric Strength

Fibrous products laminated with Bakelite, Condensite, or Redmanol, offer the Radio Expert materials of proven dependability, manufactured under definite standards, uniform and suitable for his many stringent requirements.

They will not warp, crack, blister, or flake; do not absorb oil or moisture; are easily drilled, tapped, turned, and tooled, and possess exceptional dielectric and mechanical strength.

These products are available in sheets, rods, and tubes, in shapes and sizes for every radio need.

BAKELITE CORPORATION
Address the Divisions

Divisions of BAKELITE CORPORATION

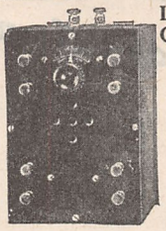
BAKELITE
General Bakelite Co.
8 West 40th St. New York

Condensite
Condensite Co. of America
Bloomfield, N. J.

REDMANOL
Redmanol Chemical Products Co.
636-678 West 22nd St.
Chicago, Ill.

Each Company maintains a research laboratory which will gladly cooperate with manufacturers in the working out of new applications.

The Material of a Thousand Uses



Loud Speaker for any Crystal Set by using the Steinmetz Amplifier, $8.50

NO STORAGE BATTERY REQUIRED

Amplifying unit uses a Westinghouse tube which requires only a single dry cell in place of the storage battery. Tube and batteries for this unit $7.95. For a two-stage amplifier use two of these units. Amplifying unit sold knocked down for $5.95. Hear the concerts all over the house.

SUPERIOR CRYSTAL SET $4.75

STEINMETZ PHONES are of exceptional merit, 2000 ohms, $5.00, 3000 ohms, $6.50; single phone, $1.75 Equal to any ten or twelve dollar phones made.

Catalog 5c at your dealers or

STEINMETZ WIRELESS MFG. CO.
Manufacturers and Engineers
5706 Penn Avenue Pittsburgh, Pa.

RADIO CABINETS
Finished or Knock Down

PANELS
Cut to Your Size

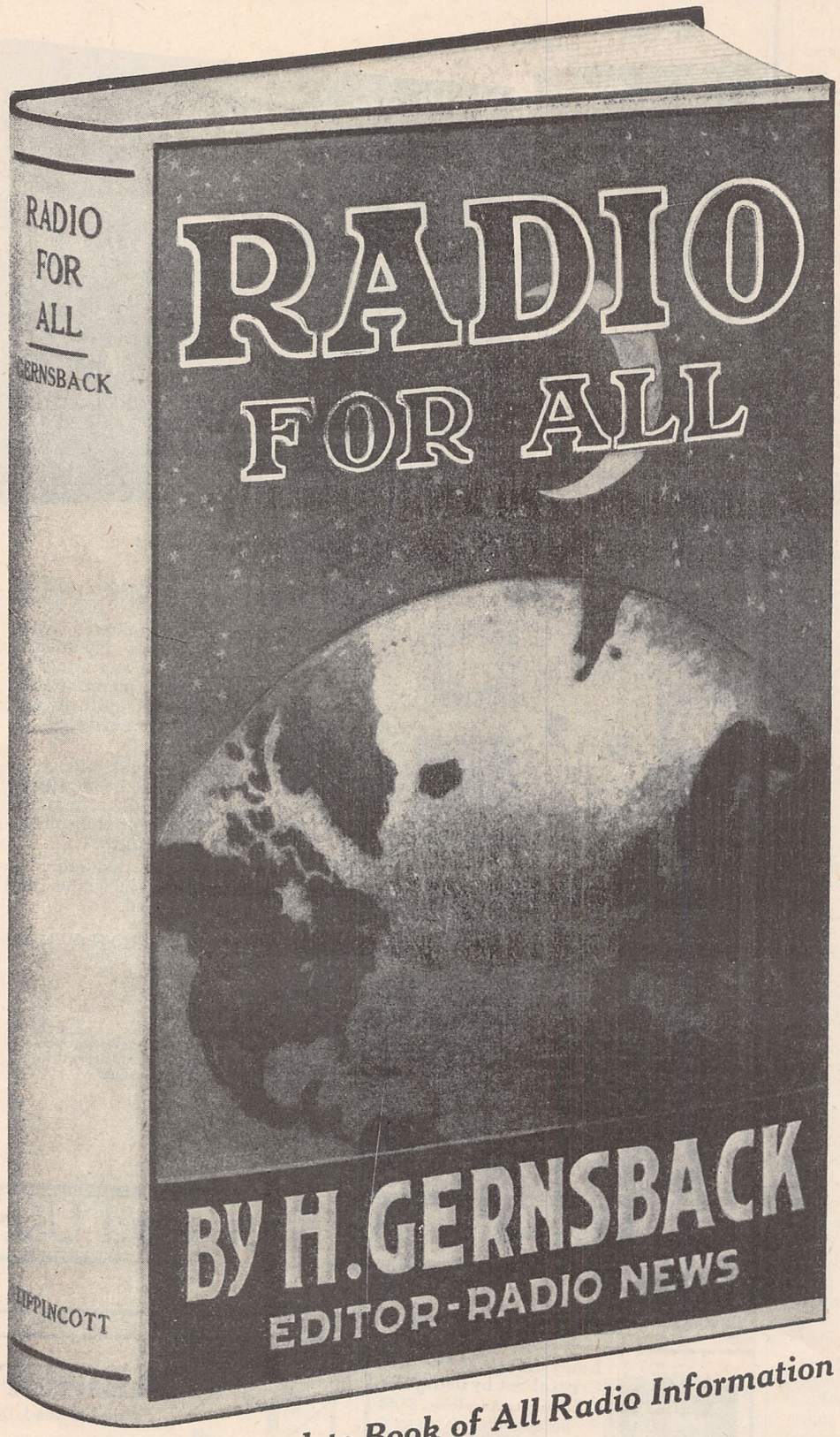
Quality **PARTS**

Write Today

Lowest Prices Direct to Consumer

CHORALEON PHONOGRAPH & RADIO CO. 223 15th Street ELKHART, IND.

Get a Handy Binder for your RADIO NEWS. Holds and preserves six issues, each of which can be inserted or removed at will. Price 65c. Experimenter Pub. Co., Inc., Book Dept., 53 Park Place, New York.



The Complete Book of All Radio Information

PRICE POSTPAID $2.00

Make all remittances payable to and mail to

EXPERIMENTER PUBLISHING CO., Inc.

53 Park Place -:- New York, N. Y.

RADIO FOR ALL

By H. GERNSBACK

Editor "Radio News," "Science and Invention" and "Practical Electrics"

With over 130 illustrations and diagrams, and 12 photographs, 300 pages, size 8¼ x 5½".

What the novice in radio needs is a book in which he can get all the information necessary for him to understand radio telephony and telegraphy, to make or buy a receiving set suitable to his means, to know how to operate his set, and, after he has an understanding of the radio art, information that will enable him to advance and get the most out of his outfit. All this must ordinarily be dug out of text-books, pamphlets and government publications, but the aim of this book is to have all the data and information that the beginner will need from the time that he takes up radio. It is a permanent, comprehensive reference book for the dyed-in-the-wool dabbler in Radio.

WHAT THE BOOK IS.

A combination of a radio course for the novice in radio telegraphy and telephony with a reference book for the more experienced amateur. Half a dozen books in one.

FOR THE BEGINNER.

The theory of radio carefully explained with drawings.

Description of and instruction for operating instruments of receiving and sending sets, with all picture diagrams of the wiring of the apparatus.

How to make your own receiving set, costing from $3.00 to $50.00.

How to read diagrams; for every picture diagram there is a corresponding technical diagram using the symbols instead of drawings.

How to tune sharply and eliminate interference from other stations.

How to protect your set from lightning, and the laws regarding installation.

Explanation of time and weather signals.

FOR THE MORE EXPERIENCED AMATEUR.

How to make a practical vacuum tube detector, two stage amplifier set costing less than $50.00, that will work.
How the radio compass works.

All about underground aerials, loop aerials and directional aerials.

Formulae for finding wave length; miscellaneous formulae for finding capacity of condenser and other instruments. Tables of wire resistances, wave lengths and their corresponding frequencies, approximate wave lengths for different aerials, tuning coil data, and much more invaluable information.

SPECIAL FEATURES.

Lists of all the broadcasting stations in the United States and Canada for concerts, time signals, weather reports, press, stock market reports, etc., with their call, wave length and time of sending.

Detailed description of Washington weather signals and their translation.

Description of a modern broadcasting station and its operation.

Large map showing location of all U. S. radio telephone broadcasting stations suitable for hanging up in radio room.

Collection of miscellaneous radio information for the amateur.

IN OTHER WORDS.

The information that you ordinarily have to dig out of government publications, text-books, pamphlets, etc., is handily combined in this one book.

game?) It is the customer's turn now and a good many of them are staying away, waiting for the dealer to come to them. The dealer who wakes up first, takes radio to the homes that are waiting and shows what it will accomplish, will do a nice business in my opinion. In the farming districts especially there seems to be a harvest waiting. Of all the farms I have visited there is not one I believe where a demonstrator would have to take a set away if he gave a decent demonstration and there was money enough to buy it. In the villages there are few sets and more are wanted, but country folks are slow and they want to know first that the durn thing is going to work.

A recent experience of mine illustrates strikingly another thing that can be done to keep the public sold. An inventor of radio and accoustic apparatus installed in the house where I live an experimental outfit that included a loud speaker. Then he arranged some programs of unusual excellence at a local broadcasting station and was all set to give the folks at our house a radio service *de luxe*. For an evening or two everybody at the house was mildly interested. Then they became blasé. Then they began to kick. The loud talker could be heard in any room in the house with the doors shut. The quality was there also. That was nice as long as folks wanted to hear it but after they tired of it it was a nuisance. So we disconnected the horn and the splendid outfit was idle for a while.

The day President Harding was to address Congress I mentioned to several members of the household that the address was to be broadcasted, and that I would bring it in if anyone wanted to hear it. They all did. When I turned on the loud speaker all other activity in the house stopped. For an hour every person there listened attentively. After that they wanted to hear Clemenceau and other notables. Those who had kicked the hardest at the ordinary programs were the loudest in their praise of radio when it brought something of real consequence. It was not a high-brow crowd either, just average folks.

Boiled down, my formula for keeping the public sold on radio, based on what I have gathered from contact with the rank and file and leaving out of consideration the man who because of natural technical tendencies will take it up and keep interested in it as a study, is as follows:

1. Push the simple receiving set and make sure that every purchaser is instructed how to get the most out of it.

2. Boost the local broadcast and make it popular, rather than those from great distances.

3. Reserve the evening hours for broadcasts that are worth while. Use pick-ups in the auditoriums where good lectures, concerts and addresses are given—the kind that many want to hear but that few can attend.

4. Encourage the youthful Marconis by giving them and their spark coils definite things to do at a certain hour or half-hour daily, and get them to listen in at other hours to pick up Government broadcasts or do something else that employs their receivers but not their transmitters. Boys must be kept busy. Repression is bad. Encourage the more advanced amateurs in their efforts to popularize continuous-wave transmission and to organize the local air so that everybody has a chance to hear what he wants to.

5. Shape the publicity so that the average man and woman will be led away from the idea that radio is a study. Sewing machines are sold because they will sew shirts and sheets, not because they show the operations of belts and cogs.

6. Encourage Government broadcasting. Let a flock of commercial broadcasters who are spending a lot of money with doubtful

Supersensitive sound mates

IT was Reginald Fessenden, distinguished radio engineer and inventor, who designed the first Brandes headset fifteen years ago. Ever since Brandes headsets have been not only supersensitive, so that they respond to the faintest signal, but *Matched Tone* headsets. Counterfeits are offered with the statement that they are "as good as Brandes"—but their phones are not supersensitive sound-mates.

In radio receiving two telephones are better than one, but only when they are absolute sound-mates.

Send ten cents in stamps for the "Beginner's Book of Radio." It explains radio in terms that anyone can understand.

Distributors and District Offices:

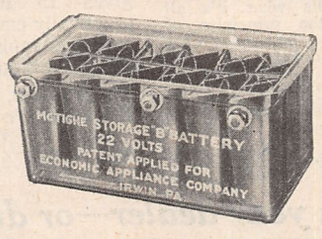
Munsey Bldg., Washington, D. C.
33 S. Clinton St., Chicago, Ill.
704 Granite Bldg., Pittsburgh, Pa.
709 Mission St., San Francisco, Cal.
76 Pearl St., Boston, Mass.
802 Forsythe Bldg., Atlanta, Ga.
1220 Nicollet Avenue, Minneapolis, Minn.
International Electric Company, Wellington, N. Z.

C. Brandes, INC
Matched Tone Headsets
TRADE MARK REG. U.S. PAT. OFF.
237 LaFayette St., New York
Dept. R. N.

Made in Canada by Canadian Brandes, Ltd., Toronto and distributed by Perkins Electric, Ltd., Montreal.

RESULT OF 15 YEARS' EXPERIENCE

McTIGHE ALKALINE STORAGE "B" BATTERY
for RADIO OUTFITS



The McTighe Storage "B" Battery is now furnished in two sizes, the original 22 volt and a new 28 volt battery, having 30 per cent more plate capacity. McTighe Batteries are absolutely noiseless, can be charged from any light socket, and are proof against damage by short circuit, overcharging or standing unused. They are furnished in oblong glass cases which nest neatly, each with its own size.
The McTighe Chemical Rectifier will charge one, two or three "B" Batteries at one time. Our Combination Magnetic Rectifier will charge 6 volt "A" Batteries or "B" Batteries up to 120 volts.

22 Volt Battery $5.00
28 Volt Battery 6.00
Chemical Rectifier ...$1.50
Magnetic Rectifier ...20.00
F. O. B. Irwin, Pa.

ECONOMIC APPLIANCE CO.
IRWIN, PENNA.

HAVE YOU SOMETHING TO SELL OR EXCHANGE?
A classified ad in RADIO NEWS will reach over 225,000 at a cost of only 15 cents a word

Get This Wonderful New Book About

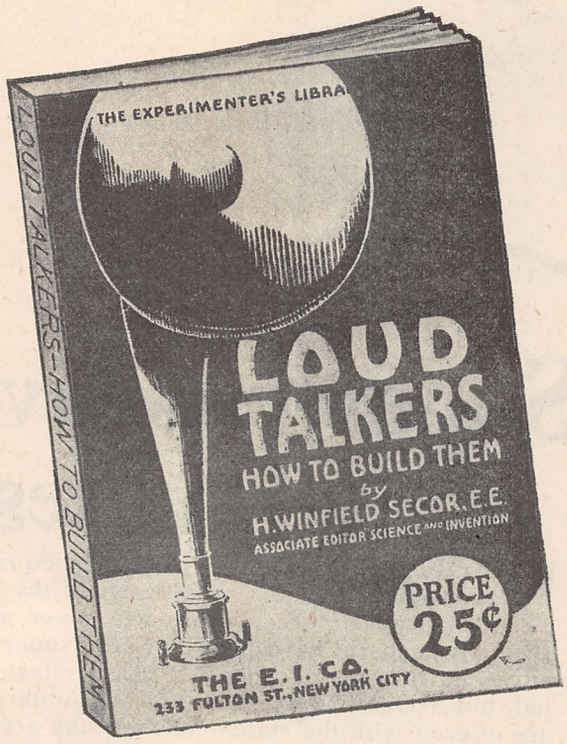
LOUD - TALKERS

HOW TO BUILD THEM

by H. WINFIELD SECOR

Associate Editor of Science & Invention

25 cents postpaid



This book describes how to build two distinct and different types of radio loud-talkers, which can be built with either electro-magnetic field to be excited from storage battery, as well as permanent magnet field requiring no separate battery excitation. The third chapter deals with improvised loud-talkers and gives clear and complete instructions on how to build suitable horns for use with radio receivers of the Baldwin and other types. Several elaborate hook-ups are given of the author's own radio receiving set, comprising one stage of radio-frequency, detector and three stages of audio-frequency amplification, together with all the connections for the loud-talker.

Complete data is given for all the parts of the loud-talkers, including the field magnet windings, as well as the diaphragm or moving coil windings, and also the step-down transformer to be connected between the vacuum tube amplifier and the loud-talker proper.

In preparing these designs the point has been constantly kept in mind to use the simplest parts possible, so that practically anyone can build a successful loud-talker equivalent to the commercial types costing $40.00 or more.

Even where the experimenter does not possess the skill or the time to make all the parts himself, which are really few in number, he may save a great deal of money, or at least half the price of a commercial loud-talker, by having the difficult parts made in a local machine shop, and then assembling them and winding the coils himself. Circuit connections and data for the size of wire, etc., are given for placing the loud-talker on a separate floor or in another part of the house not occupied by the radio receiving set. A very valuable book, giving data which cannot be obtained anywhere else and which has not been published before.

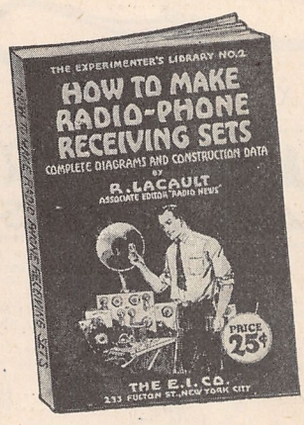
64 *pages, 25 illustrations, bound in beautiful two-color cover, size 5½ x 7½ inches; Price prepaid, 25 cents*

Have You a Copy of These Two Books?

HOW TO MAKE RADIO-PHONE RECEIVING SETS

By ROBERT E. LACAULT
Associate Editor RADIO NEWS

25c



A non-technical book for the beginner. Gives complete constructional data on the building of a complete Crystal Detector Set, Tuning Coil, Loose Coupler and a Single Audion Tube Set with Amplifying Units. It furnishes all dimensions and working drawings of every part that must be constructed by the amateur. Written in plain, simple language that anyone can understand. The opening chapter gives a complete description of the theory of radio and tells what it's all about, teaching the principles of wireless so that the constructor knows what he is doing.

48 *pages, 26 illustrations*
Bound in Beautiful Two-Color Cover
Size, 5½x7½ in. Prepaid 25c.

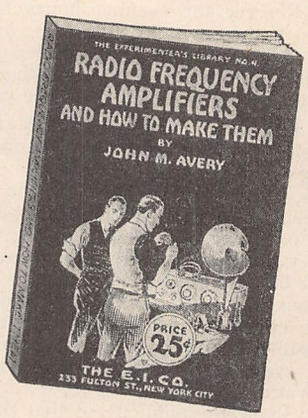
RADIO FREQUENCY AMPLIFIERS AND HOW TO MAKE THEM

By JOHN M. AVERY

25c

This book is for the more advanced amateur, showing the construction of the Radio Frequency Amplifying Transformer and giving complete constructional data. It shows the application of Radio Frequency to amplifying units that the amateur may already possess and gives 15 hook-ups showing practically every use Radio Frequency Amplifying Transformers can be put to.

32 Pages, 15 illustrations
Bound in Beautiful Two-Color Cover
Size, 5½x7½ in. Prepaid, 25c.



Order from your dealer—or direct from us

THE E. I. COMPANY

233 FULTON STREET
NEW YORK CITY, N. Y.

results get out from under, but do not let two or three powerful corporations get a monopoly of the air unless we are satisfied to trust the future entirely in their hands.

The First High Power Broadcasting Station in Havana, Cuba

(*Continued from page* 1440)

their reach, there being no necessity of forcing the interest of these persons towards the performers or the performance. It comes with the application of modern sets to the home fireside.

Later in the night's program, the President of the Radio Club de Cuba spoke to the Cuban amateurs explaining the need of all of them assembling together to demonstrate to our government the veritable wish of everyone to place himself within the limits of the law and the enforcements thereof. In another issue I will reproduce his speech together with the story of radio in Cuba, since its very beginning to the brilliant role it is taking in its progress.

A Novel Detector

(*Continued from page* 1481)

which can be placed to suit the builder and you then have a detector that can be adjusted in every way. I am not giving dimensions of all the parts, for it is so simple it can be seen from the sketch or left to the discretion of the builder.

Contributed by JOHN F. DREPER

Our Popularizing Radio Scheme

(*Continued from page* 1453)

tricts cannot afford to invest in complicated and expensive apparatus.

Therefore, your plan appeals to me very much, and the idea of having one man invest in the complicated and expensive apparatus to re-broadcast locally to cheap apparatus, which he rents out, seems to me to be an excellent project. There is, of course, the difficulty of obtaining a new legislation, which I believe may be required, to enable broadcasting to be carried out by these relay stations on 200 meters, but this may be overcome. There is also the more difficult technical question of relaying the broadcasted matter without introducing further distortion in the message. I think that this is the most difficult point, but with correctly designed apparatus, properly controlled, the added distortion should be reduced to a minimum.

I think that the contribution, which you have made in your scheme, is a valuable one. Every effort must be made to keep alive the public interest in this matter. I firmly believe that the future of broadcasting is a great one. There is no other agency by which we can send a message instantly to 360 degrees of the compass. Radio broadcasting has no rival.

JOHN HAYS HAMMOND, JR.

FROM H. M. KONWISER

In reference to your editorial "Popularizing Radio," please note that the undersigned is of a general mind to approve anything you suggest for the further advancemcnt of Radio.

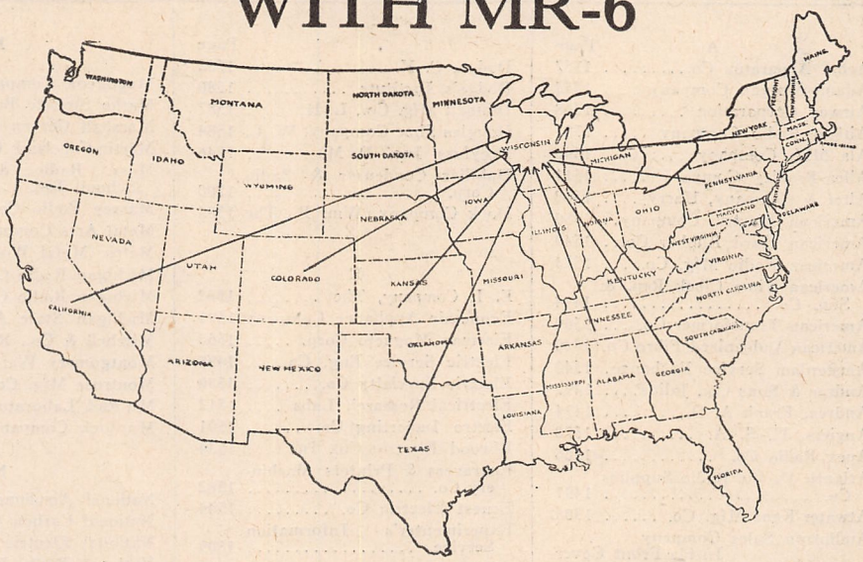
A careful reading of your article puts me in accord with your interesting proposition on re-broadcasting broadcasting. The plan as laid out by you seems entirely feasible and ought to be tried out.

H. M. KONWISER,
Publisher *The Radio Dealer.*

FROM A. B. MACATTAMMANY

The writer has read with care your acutely intelligent and very comprehensive editorial *"Popularizing Radio"* and he will

WISCONSIN LISTENS TO THE WORLD WITH MR-6



FROM Wisconsin alone during one month come reports of De Forest MR-6 Receiving Sets getting California, Colorado, Kansas, Texas, Tennessee, Georgia, Kentucky, Pennsylvania, and New York—distances up to 1500 miles. One man listened across the entire continent, getting Santa Cruz, California and Atlanta, Georgia, the same evening. The unsolicited testimonials as to the way this efficient but inexpensive set "listens to the world" are on file in our office and copies will be sent to anyone interested in writing direct to the owner.

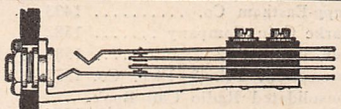
Multiply such experiences as these by the thousands of MR-6 sets in use all over the nation—to say nothing of the De Forest Everyman and Radiohome sets—and you get an idea of the way De Forest is serving the nation with the joys of radio.

De Forest manufactures receiving sets all the way from the least expensive to the most elaborate, and laboratory tested high quality parts for those who "build their own." If it's De Forest, it's built in a way worthy to sustain the reputation of that great name.

If you want the best radio has to offer—the songs, the stories, the news of the world—more clearly than you have believed possible and from farther away—you can't go wrong on De Forest!

DEFOREST RADIO TEL. & TEL. CO.

JERSEY CITY, N. J.



CARTER *"TU-WAY"* Plugs and *"HOLD-TITE"* Jacks

Carter *"TU-WAY"* Plug takes ONE to FOUR phone sets at the same time. Connects with ANY kind of terminal. Price $1.50

Carter *"HOLD-TITE"* Jack; wide frame heavy phosphor-bronze springs; no spacer washers necessary. One to five springs. Price .....70c to $1.10

NEW CARTER VERNIER CONTROL RHEOSTAT with NICHROME wire and pigtail connections. Price $1.25

NEW CARTER AUTOMATIC PLATE CIRCUIT CONTROL RHEOSTAT eliminates change-over switches, filament control jacks, asd first and second stage jacks. Price.....$2.00

Sold by all good electrical and Radio Jobbers. Write for bulletin on these and other Carter products.

New Control Switches of all types.

CARTER RADIO CO. 209 S. State Street CHICAGO

Insure your copy reaching you each month. Subscribe to Radio News—$2.50 a year. Experimenter Publishing Co., 53 Park Place, N. Y. C.

Index to Advertisers

A

Page

Acme Apparatus Co. 1557
Adams-Morgan Company 1553
Airway Corporation 1568
Aitken Radio Company 1587
Ala Mfg. Company 1560
Allen-Bradley Company 1511
Alter & Company, Harry 1568
American Electric Company.. 1580
American Hard Rubber Co... 1549
American Radio Mfg. Co. ... 1573
American Time Clock Rep. & Sup. Co. 1494
American Transformer Co. ... 1560
American Vulcanized Fibre Co. 1540
Amsterdam Service Exchange. 1542
Andrae & Sons Co., Julius.... 1492
Andrea, Frank A. D. 1494
Angiers, U. S. A. 1572
Apex Radio Co. 1566
Atlantic-Pacific Radio Supplies Co. 1491
Atwater-Kent Mfg. Co. 1505
Audiotron Sales Company Inside Front Cover
Automatic Electrical Devices Co., The 1528
Autoyre Company 1576

B

Bakelite Corp. 1589
Barawick Co., The 1502-1503
Barkelew Elec. Mfg. Co., The 1527
Bates & Company 1567
Belden Mfg. Co. 1510
Bell Mfg. Co. 1540
Bergen Radio Supply Co. ... 1546
Bogue, B. N. 1586
Boice, W. & J. 1500
Box No. 56 1568
Brach Mfg. Company, L. S... 1542
Brandes, Inc., C. 1591
Briggs & Stratton Co. 1433
Bright Star Battery Co. 1578
Broadway Electrical Novelty House 1562
Brooks Appliance Company.. 1552
Bruno Radio Corp. 1572
Bunnell & Company, J. H..... 1556
Burrowes Company, E. T. .. 1586

C

C. & K. Radio Mfg. Co..... 1577
Carter Radio Co. 1593
Central Radio Labs. 1576
Central States Engineering.. 1570
Chaslyn Company 1566
Chelsea Radio Company 1548
Chemical Institute of New York, Inc. 1499-1586
Cherpeck, C. S. 1562
Chicago Radio Apparatus Co. 1572
Chicago Salvage Stock Store. 1548
Choraleon Phonograph & Radio Co. 1589
Clapp-Eastham Co. 1493
Clarke Coin Company 1582
Cole, Inc., A. B. 1581
Connecticut Tel. & Elec. Co. 1577
Consolidated Radio Call Book Co. 1504-1588
Continental Fibre Co., The... 1517
Continental Radio & Electric Corp. 1524
Copper & Brass Research Corp. 1556
Copper Clad Steel Company.. 1574
Coto Coil Company 1564
Coyne Trade Schools 1586
Crosley Mfg. Company..... 1519
Cutler-Hammer Mfg. Co. 1555
Cut Rate Radio Company.... 1562

D

DeForest Radio Tel. & Tel. Co. 1593
Delfelco Battery Corp. 1564
Demaree, C. S. 1500
DeRoy & Sons, Jos. 1586
Diamond State Fibre Co. 1521
Dictograph Products Corp.... 1558

Page

Dodge, C. K. 1532
Dodge's Institute 1580
Donnell Mfg. Co., L. H. 1587
Douglas Shoe Company, W. L. 1584
Dreyfuss, Inc., P. M. 1546
Dubilier Condenser & Radio Corp. 1500
Duck Company, Wm. B., The 1583

E

E. I. Company, The 1592
Economic Appliance Company 1591
Eiseman Magneto Corp. 1562
Electric Service Eng. Co..... 1498
Electric Specialty Co. 1530
Electrical Research Labs 1512
Electro Importing Co. 1501
Elwood Electric Co., Inc..... 1534
Engravers & Printers Machinery Co. 1562
Ernest Electric Co. 1544
Experimenter's Information Service 1509

F

F. R. S. Radio Corp. 1564
Fedders Mfg. Company, Inc. 1565
Federal Tel. & Tel. Co. 1563
Finch Radio Mfg. Co. 1508
Formica Insulation Co. 1507
France Mfg. Co., The 1550
Freshman Co., Inc., Chas. 1506-1566
Frost, Herbert H. 1438

G

Galena Crystal Mfg. Co. 1536
Gehman & Weinert 1576
General Electric Co. 1585
General Radio Company 1566
General Radio Corp. 1574
Goodell-Pratt Company 1571
Goodman, L. W. 1512
Gould Storage Battery Co... 1498
Great Lakes Radio Co. 1497
Grebe & Co., Inc., A. H. 1435

H

Harris Laboratory, The..... 1572
Hayden Radio & Research Co., A. C. 1574
Hayes & Newton 1524
Herald Laboratories, Inc. Inside Back Cover
Hinrichs Knoop Company ... 1570
Hipwell Mfg. Co. 1561
Hygrade Electrical Novelty Co. 1514
Hyman & Co., Inc., Henry.. 1569

I

International Insulating Corp. 1554
Inter-Ocean Radio Corp..... 1579
Izenstark Radio Co. 1556

J

Jackson & Co., J. L. 1582
Jefferson Electric Mfg. Co. .. 1580
Johnson, G. F. 1522

K

Kellogg Switchboard & Sup. Co. 1567
Kennedy Co., Colin B., The.. 1513
Kensington Radio Supply Co. 1494
Killoch Company, David 1579
Kimley Electric Co. 1576
King Am-Pli-Tone 1574
Klein Radio & Electrical Sup. Co., The 1574
Klosner Improved Apparatus Co. 1569

L

Lancaster & Allwine 1582
LeFax, Inc. 1566
Lewis & DeRoy Radio Corp... 1566
M. P. M. Sales Co. 1585

M

Page

Magnavox Company, The ... 1541
Marko Storage Battery Co. .. 1576
Marshall Gerken Co., The.... 1518
Martin-Copeland Co. 1515
Mass. Radio & Telegraph School, Inc. 1564
Massey Radio Co. 1500
Metal Arts Company, Inc. ... 1580
Metric Metal Works 1558
Michigan Radio Co. 1580
Michigan Radio Corp. 1514
Michigan State Auto School. 1580
Mitchell & Co., R. 1573
Montgomery Ward & Co..... 1522
Montrose Mfg. Co. 1576
Mu-Rad Laboratories, Inc. .. 1516
Murdock Company, Wm. J... 1578

N

National Airphone Corp. 1529
National Carbon Co., Inc. ... 1531
National Electric Novelty Co. 1575
National Radio Institute 1506-1545
National Radio Products Corp. 1556
National Service Company .. 1508
New Haven Radio Company.. 1498
Newman-Stern Company, The 1550
New York Coil Co. 1518
Nick's Radio Shop 1522
North American Radio & Sup. Corp. 1500
Northern Industrial Chemical Co. 1518
Novo Mfg. Co. 1572

O

O'Brien, Clarence A. 1582
Omnigraph Mfg. Co., The.... 1538
Owen, Richard B. 1580
Ozburn Abston Radio Co. ... 1538

P

Pacent Electric Co. 1543
Parker, C. L. 1582
Philadelphia Storage Battery Co. 1495
Philadelphia Wireless Sales Corp. 1534
Picard Radio Corp. 1566-1568-1584-1587
Pignolet Instrument Co. 1554
Pioneer Radiophone Corp... 1548
Pitts Company, F. D. 1563
Pittsburgh Radio & Appliance Co. 1570
Pittsfield Machine Tool Co... 1494
Porell Co., Inc., George H. .. 1558
Precision Equipment Co., The 1552
Premier Accessory & Specialty Corp. 1526

R

Radiall Company 1578
Radio Consultation Bureau.. 1554
Radio Corporation of America 1537
RadioCraft Co. 1508
Radio Cut Price Company... 1574
Radio Directory & Publishing Co. 1538-1578
Radio Distributing Co., The.. 1568
Radio Equipment Co. 1547
Radio Experimenters League.. 1562
Radiogem Corp., The 1561
Radio Guild, The, Inc. 1535
Radio Improvement Co. 1542
Radio Industries Corp. 1533
Radio Institute of America... 1566
Radio Instrument Co. 1565
Radio Instrument & Panel Co. 1544
Radio Parts Mfg. Co. 1498
Radiophone Equipment Co. .. 1540
Radio Research Guild 1570
Radio Service & Mfg. Co. ... 1574
Radio Shop of Newark 1542

Page

Radio Specialty Co. 1600
Radio Stores Corp. 1558
Radio Testing Station 1568
Rasla Sales Corp. 1578
RaTone Electric Company ... 1578
Rauland Mfg. Company 1571
Regal Typewriter Co., Inc.... 1584
Remler Radio Mfg. Company 1595
Reynolds Radio Co. 1564
Rhamstine, J. Thos. 1564
Ridgewood Radio Shop, The. 1536
Roller-Smith Company 1522
Rose Radio Supply 1560
Rusonite Products Corp. 1595

S

Sadler Mfg. Co. 1520
Saturn Mfg. & Sales Co., Inc., The 1550
Schindler, Chas. 1546
Scholes Radio & Mfg. Corp... 1523
Schweitzer & Conrad, Inc. .. 1562
Screw Machine Specialty Co... 1576
Ship Owners Radio Service, Inc. 1532
Sidbenel Radio Equipment Mfg. Co. 1559
Signal Electric Mfg. Company 1587
Signal Radio & Electric Corp. 1554
Sinclair, Mr. 1518
Smith, F. G. 1574
Smith & Heminway Co., Inc. 1506
Southern Toy Company, The . 1520
Spaulding & Sons Co., Inc., J. 1540
Springfield Wire & Tinsel Co. 1546
Standard Metal Mfg. Co.... 1572
Standard Radio & Electric Co. 1583
Star Mfg. Company 1572
Starr Piano Company 1552
Steinmetz Wireless Mfg. Co... 1589
Stover Mfg. & Engine Co... 1510
Stromberg Carlson Tel. Mfg. Co. 1496
Superamplifier Company 1544
Superior Radio & Telephone Equip. Co., The 1496

T

Telephone Maintenance Co.... 1536
Thornton Transformer Co., Inc. 1518
Tifinite Co., The 1516
Times Appliance Co., Inc.... 1568
Timmons, J. S. 1544
Trade Circular Addressing Co. 1500
Trimm Radio Mfg. Co. 1562
True Tone Radio Mfg. Co. .. 1560
Tuska Company, C. D., The 1525
Twentieth Century Radio Corp. 1572

U

Union Construction Corp. .. 1510
United Mfg. & Distributing Co. 1552
U. S. Storage Battery Co... 1548
Universal Chiropractors' Ass'n., 1436-1437
Universal Radio & Research Co. 1564

V

Valley Electric Co. 1580
Ve-De-Co Radio Mfg. Co... 1570
Veritas, M. 1582
Vesco Radio Shop 1573
Vesta Battery Corp. 1566

W

W. E. Supply & Service Corp. 1578
Walbert Mfg. Co. 1496
Ware Radio Corp. 1581
Washington Automobile Supply Co. 1576
Waveland Radio Co., Inc. 1550
Webster Electric Co. 1551
Westinghouse Union Battery Co. 1575
Weston Electrical Instrument Co. 1528
Westwyre Radio Co. 1566
Wicks Electrical Institute .. 1586
Willard Storage Battery Co. 1539
Williams Specialty Co. 1536
Wilmington Fibre Specialty Co. 1498
Wilson Utensil Company 1526
Wireless Mfg. Co., The 1530
Wireless Shop, The 1498
Workrite Mfg. Co., The. Back Cover
World Battery Co. 1514

Y

Y. M. C. A. Radio School... 1516

say in his opinion, you have hit the nail on the head and solved a problem that has lacked a solution until you did so.

Practical and commercial ideas such as this, one will lead the straying radio industry into the right path of prosperity and out of a depressing condition of the trade.

Yours for all friendliness and competitive co-operation, we remain,

ARTHUR B. MACATTAMMANY,
Publisher, *Radio Retailer & Jobber.*

FROM E. L. BRAGDON

Your editorial on *"Popularizing Radio"* is a very apt one at this time. The cities are criss-crossed with aerials and the owners of sets are oftentimes perplexed as to the program to be selected.

But out in the country where the mass of citizens reside only one or two here and there are able to pay out the money for the type of receiving set necessary for the distance reception of broadcasted entertainments.

During the winter at least, when the air is clearest and free from objectionable interferences your plan should work out to perfection. If it is started by someone experienced in the work the manufacturers of crystal sets and of the less expensive tube sets will be forced to night work to fill the demand for their outfits. More success to you.

E. L. BRAGDON,
Radio Editor, New York, *Globe.*

WJZ HEARD IN ENGLAND

A woman singing in the United States, 3750 miles away, was heard in England Dec. 3. On Sunday a week ago Mr. J. H. D. Ridley, chief test room operator for Messrs. Burndept, Ltd., wireless engineers of Blackheath, picked up portions of a wireless concert broadcast in Newark, N. J. Later he tried to repeat the experience. Sitting in his room in Croydon, he turned in for the Newark broadcasting station, whose wave length in 325 meters. Conditions were not good, with a humid atmosphere and low clouds, but the test was a success. The items picked up were:

At 2 A. M., English time, a violin and piano solo; 2:11 A. M., a woman singing; 2:25 A. M., piano solo; 3:12 A. M., a speech, but the words were not distinguishable owing to adjustments being made at the time; 3:44 A. M., dance music.

Mr. Ridley said his experience refutes any suggestion of freak reception. He heard distinctly the call of Newark, "WJZ."

Edwin N. Mayall of Hunt's Cross, Liverpool, states that between 1 A. M. and 3 A. M. recently, on a three valve receiving set of his own construction, he heard a wireless telephone program transmitted from the New Jersey broadcasting station.

(*Abstract from N. Y. Times*).

A GUIDE'S LETTER

The following letter was recently received by the General Electric Company:

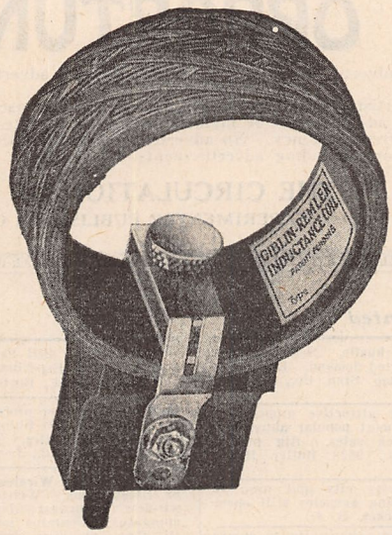
"WGY, Schenectady General Store,
New York States.
Sir:

i am gide for hunter man wot come at dis place Lac-des isle for hunting deer. dese hunter man bring it wit him a machine for heer you spik sunday nite also tuesday nite i hear song about my old modder dats long tim i dont see my modder and i ting dats dame fine song also i heer oder song i dont no de nam. tuesday nite storie for de small boy and girl bout mak de star shine for dem if dey is good boy and girl. hunter man laff lik hell an tole me ax you how we mak some moon shine.

i hear you spike jus de same lik your at me place i ting you have good machine i lissen more nex week

tank you and much oblige

gide Camille Poirier
Chemis P. O., Quebec, Canada.



Interchangeable with all Coil Mountings.

The Most Efficient Compact Inductance Ever Used in Radio.

The superior performance of

GIBLIN-REMLER INDUCTANCE COILS

is responsible for their big demand.

AN ENGINEERING HISTORY OF THE MOST EFFICIENT INDUCTANCE COIL EVER DEVELOPED

THEORETICALLY the ideal inductance coil should have all inductance—no capacity — no resistance — and no natural period. Such a coil would result in maximum signal strength with no interference from signals that were not on exactly the same wave length as the signals being received.

Thomas P. Giblin, the radio engineer who originated the compact inductance coil also designed the first of his coils to appear on the market with single lattice, or so called honeycomb winding. Through study and research, this winding was slightly improved by Mr. Giblin in staggering the turns between layers resulting in a multi-lattice, or so called duolateral winding.

However, Mr. Giblin felt confident that he could produce a coil that would come much nearer to having the characteristics of a theoretically "perfect inductance." Complete success was finally achieved when the present Giblin-Remler coil — THE MOST EFFICIENT COMPACT INDUCTANCE EVER USED IN RADIO—was developed.

In this coil the turns are wound close together, resulting in a greatly increased inductance for the same amount of wire. Hence the resistance is lower for a given inductance. The slight increase of capacity between turns has been many times compensated for by a greatly decreased capacity between layers resulting from spacing the layers with a cotton yarn of high dielectric strength. The result was a new coil having MORE INDUCTANCE—LESS DISTRIBUTED CAPACITY — AND A LOWER NATURAL PERIOD THAN ANY PREVIOUS COIL. Furthermore, the new coil has maximum insulation between layers at the point of greatest potential difference.

Under actual tests, this coil showed such wonderful improvement over his earlier forms of winding that Mr. Giblin indorsed it with his name.

Write direct for complete specifications and table of constants for this new inductance coil.

The Remler Technical Bureau is at your service. Address your problems to Dept. N.

REMLER RADIO MFG. COMPANY

FACTORY and HOME OFFICE
248 FIRST STREET
SAN FRANCISCO, CALIF.

EASTERN SALES OFFICE
154 W. LAKE STREET
CHICAGO, ILLINOIS

$100.00 EXTRA You Can Make It This Month In Your Spare Time If You Will

In your community there are subscribers to Radio News and to Science & Invention who will wish to renew their subscriptions in the next few months—there are a lot of people who would subscribe upon solicitation—if you called with a sample copy and asked them to do so.

We pay the same commission for the renewal as for a new subscription.

For particulars, sample copies, etc., write to

C. J. WOLFE
Experimenter Publishing Co.
53 Park Place **New York**

RUSONITE

CRYSTAL RECTIFIER
MULTIPOINT (Patent Pending)

A Synthetic CRYSTAL DETECTOR, sensitive over its entire surface.
Eliminates all detector troubles. Extraordinary clearness and volume. Endorsed by Radio experts and press. Sold in Sealed Packages only. The Standard Crystal.

Price, Postpaid, mounted
Sensitiveness guaranteed

RUSONITE CATWHISKER **25c**
14 Karat Gold Super-Sensitive

Order from your dealer or direct from us.
RUSONITE PRODUCTS CORP.
15 Park Row, N. Y. **Dept. "N"**

OPPORTUNITY AD-LETS

Follow these advertisements every month. Reliable advertisers from all over the country offer their most attractive specials in these columns.

Classified advertising rate fifteen cents a word for each insertion. Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than 10 words accepted.

Objectionable or misleading advertisements not accepted. Advertisements for the April issue must reach us not later than February 1st.

THE CIRCULATION OF RADIO NEWS IS OVER 225,000

EXPERIMENTER PUBLISHING CO., INC., 53 Park Place, New York, N. Y.

Agents Wanted

$75-$150 weekly assured if you hustle. Sell attractive gold signs to stores, offices. Unlimited demand. Experience unnecessary. Free Samples. Acme Sign Co., 363 W. Superior, Chicago.

Ambitious men, write today for attractive proposition, selling subscriptions to America's most popular automobile and sportsman's magazines. Quick sales. Big profits. Pleasant work. Digest Pub. Co., 9528 Butler Bldg., Cincinnati.

Amateur Agents Wanted in every city and town to sell radio apparatus. A few stocking agencies still open. Delfelco, 12 Meeting Street, Pawtucket, R. I.

We Wish Representatives in every community to secure subscriptions for Radio News, Science and Invention, and Practical Electrics. This is a wonderful opportunity for Amateur Radio Enthusiasts to make big money quickly. Write Experimenter Publishing Co., Inc., 53 Park Place, New York City.

Agents, Salesmen: Sell complete Radio Receiving Sets, part or all time. Special introductory prices, 30 days' free trial, dealers or direct. Wonderful opportunity. Protected territory. Your outfit free. Home Radio Phone Co., 115 No. Desplaines, Chicago.

Tremendous Opportunity for ambitious agents. The indispensable, rapid selling Speedy Dish Washer. Price $3.50. No competition. No investment. Easy selling plan. Convenient sample. Commission daily. Make application today—exclusive territory. Shepperd-Luth Mfg. Co., 16 W. Hudson St., New York.

Agents Wanted in every city and town to sell standard radio apparatus. Attractive discounts given. If interested, write us at once stating age and radio experience. Wilmington Electrical Specialty Co., Inc., 912 Orange St., Wilmington, Delaware.

American Made Toys

Manufacturers on Large Scale, also homeworkers, wanted to manufacture Metal Toys and Novelties. Millions needed of Barking Dogs, Wag Tail Pups, Wild Animals, Automobiles, Indians, Cowboys, Baseball Players, Cannons, Toy Soldiers, Crowing Roosters, Statues of Liberty, Miniature castings of Capitol, Bathing Girl Souvenirs and others. Unlimited possibilities. Guaranteed Casting forms furnished manufacturers at cost price from $5.00 up, with complete outfit. No experience or tools necessary. Thousands made complete per hour. We buy goods all year and pay high prices for finished goods. Cash on delivery. Contract orders placed with manufacturers. Catalog and information free. Correspondence invited only if you mean business. Metal Cast Products Co., 1696 Boston Road, New York.

Automobiles

Automobile Owners, garagemen, mechanics, send today for free copy of this month's issue. It contains helpful, instructive information on overhauling, ignition troubles, wiring, carburetors, storage batteries, etc. Over 120 pages, illustrated. Send for free copy today. Automobile Digest, 528 Butler Bldg., Cincinnati.

Business Opportunities

Become a Landscape Architect. Dignified, Exclusive Profession. Little competition. $5,000.00 to $10,000.00 income for experts. Easy by our method. Begin earning 3 weeks after you enroll. Write today. American Landscape School, 11R, Newark, N. Y.

Start a Collection Bureau at home, spare time, full particulars 10 cents, best System, many have taken this opportunity, why not you? Andrew Kulik, Epton, Penna.

Wanted—District Purchasing Agents. National Instrument Co., 4717 North Hamilton, Chicago.

Advertsiers. Send for our free lists. Pennell Company, Covington, Kentucky.

Chemistry

Learn Chemistry at Home—Dr. T. O'Conor Sloane, noted educator and scientific authority, will teach you. Our home study correspondence course fits you to take a position as chemist. See our full page ad on page 1499 of this issue. Chemical Institute of New York, 140 Liberty Street, New York City.

Correspondence Courses

Correspondence Courses at less than half original prices. Any school, any subject for men or women. Bulletin 1074 free. Courses bought. Instruction Correspondence Exchange, 1966 Broadway, New York.

Dollars Saved—Used correspondence courses of all kinds sold, rented and exchanged. List free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

Electric Supplies and Appliances

Electric Tattooing Outfits. Illustrated Catalogue, 10c. Waters Mfg., 1050 Randolph, Detroit.

Books

We Buy and Sell back issues of Radio Amateur News and Electrical Experimenter. Boston Magazine Exchange, 109 Mountfort St., Boston, Mass.

Sexology Books for professional and advanced student readers. Forel, Krafft-Ebing, Kisch, Robie, Ellis, Fraud, Key and other authorities. The Modern Book Association, 4150 Santa Monica Blvd., Los Angeles, Calif.

How to Make Wireless Sending Apparatus.—100 pages—88 illustrations. Written and published entirely for the wireless enthusiast who wants to make his own radio apparatus. Contains more information on "how to make it" than any other book we know of. Paper bound, 35c. postpaid. Experimenter Publishing Co., Book Dept., 35 Park Place, New York City.

Experimental Electricity Course in 20 Lessons. By S. Gernsback and H. W. Secor, E. E. A course of the theory and practice of Electricity for the Experimenter. Every phase of experimental electricity is treated comprehensively in plain English. New experiments are described and explained and nearly every application of Electricity in modern life is given. 160 pages—400 illustrations. Flexible cloth cover, 75c. postpaid. Stiff cloth cover, $1.25 postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

Wireless Course in 20 Lessons. By S. Gernsback, A. Lescarboura and H. W. Secor, E. E. Tells you everything you want to know about "Wireless"—theory, practice and history. A clear, concise course on every phase of this subject. 160 pages—350 illustrations. 30 tables. Stiff cloth cover, $1.75 postpaid. Experimente Publishing Co., Book Dept., 53 Park Place, New York Ci

The How and Why of Radio Apparatus, by L. W. Secor, E. E. This newest book on radio matters fulfills a distinct gap in wireless literature in that, while the treatment is made as understandable and as free from mathematics as possible, it at the same time incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as teachers and students of the subject in general. A very broad field has been covered by the author, at the same time giving a great deal of information not found in other text books. If you are engaged in any branch of the Radio or allied arts at all you will surely need this latest contribution to radio literature, which is destined to be found on every radio man's book shelf before long. A glance at the following list of chapters gives but a very scant idea of the extensive and useful radio knowledge provided in its text: The Induction Coil; The Alternating Current Transformer; Radio Transmitting Condensers; The Spark Gaps; Radio-Transmitting Inductances; Radio Receiving Tuners; Radio Receiving Condensers; Detectors; Telephone Receivers; Radio Amplifiers; Construction of a Direct Reading Wavemeter and Decremeter; Antenna Construction; The Calculation and Measurement of Inductances; Appendix containing very useful tables, covering all subjects treated in this very unusual book. This newest of Radio Works, cloth bound in Vellum de Luxe, Gold Stamped and Hand Sewed, has 160 pages. Size of book, 6x9 inches. The How and Why of Radio Apparatus. Postpaid, $1.75. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

Exchange

Amateur Agents wanted in every city and town to sell radio apparatus. A few stocking agencies still open. Delfelco, 12 Meeting Street, Pawtucket, R. I.

For Sale—Twenty-watt phone set in excellent condition, a wonderful bargain. Fred Legler, Redfield, So. Dakota.

For Sale—Large omnigraph, practically new. Ernest Mason, No. Reading, Mass.

First Money Order $40.00 takes new RA10 Paragon Receiver. Sam McMaster, Bellefourche, So. Dakota.

Sacrifice: York Trap Drums brand new. Magnavox $35.00. A. Noaker, 140 Liberty, Bowling Green, Ohio.

Radio Telephone Outfit for sale. Complete with all latest materials used. Paragon Circuit including Storage Battery and Rectifier. Write Paul Rymond, 73 N. Pine St., Hazleton, Pa.

Must Sell—Two Step amplifier, $20.00; Loud speaking receiving set complete, with bulbs, Baldwin phones, etc., $85. Write Joseph Smith, 1290 Belvidere Ave., Detroit, Mich.

For Sale—Manufacturer Operating to capacity on other lines, will sell high class tools, parts and complete condensers and detectors. Write United Service Advertising, 222 Market St., Newark, N. J.

Ford Owners

Sport Cars, fast, saucy, hug the turns and stick to the road—make you glad you're a Ford owner. Can easily be built by aid of life-size "Red-i-Kut" patterns and picture instructions. The "Pal" system delivered complete with pressed metal streamline tail for $6.40. Garage men make big money building them. Send 5-cent coin for prospectus on making sport cars—Jiffy Tops and Gosum Windshields. Kuempel Co., 314 Kuempel Bldg., Guttenberg, Iowa.

Health

Diseases and Their Innate Healer. Book 50c. Arthur J. Stevens, Wauseon, Ohio.

Tobacco or Snuff Habit Cured or no pay; $1 if cured. Remedy sent on trial. Superba Co., S.B., Baltimore, Md.

Help Wanted

All men, women, boys, girls, 17 to 60, willing to accept Government Positions, $117-$190, traveling or stationary, write, Mr. Ozment, 251, St. Louis, immediately.

Be a Mirror Expert, $3-$10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors. French method. Free prospectus. W. R. Derr, Pres., 26 McKinley St., Baldwin, N. Y.

Be a Detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 964 Westover Bldg., Kansas City, Mo.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665, St. Louis, Mo.

Get posted for Spring—Good prices paid for butterflies, insects. See Sinclair display advertisement, page 1518.

Insects Wanted

Get posted for Spring—Good prices paid for butterflies, insects. See Sinclair display advertisement, page 1518.

Instruction

Learn Chemistry at Home—Dr. T. O'Conor Sloane, noted educator and scientific authority, will teach you. Our home study correspondence course fits you to take a position as chemist. See our full page ad on page 1499 of this issue. Chemical Institute of New York, 140 Liberty Street, New York City.

Mouth-Organ Instructor, 25c; play in one hour. Boxing Instructor, 25c. Minstrel Show Guide, 10c. Elsea Co., Bowling Green, Ohio.

Mathematics Taught by Mail. Arithmetic, Algebra, Geometry, Mensuration, Trigonometry, Logarithms, and Mechanics courses. Harding School, 76 Brighton, Highland Park, Michigan.

Used Correspondence Courses only one quarter original price. Free bargain price list 1000 courses. Courses bought. Students' Exchange, 45 West 42d St., New York.

Vibrations, Lights, Colors, Sound (illustrated) Electronic Radio Active Principles. Write for table contents — 242 Powell, San Francisco, Calif.

Languages

World-Romic System. Master key to All Languages. Primers, 15 languages, $1.94 each language; Arabic, Chinese, Danish, Dutch, English, French, German, Italian, Japanese, Panjabi, Polish, Portuguese, Russian, Spanish, Swedish. Pronunciation-Tables, 92 languages, 30c each language. Languages Publishing Company, 8 W. 40th Street, New York.

Mail Order Business

$50 week evenings. I made it. Mail Order Business. Booklet for stamp tells how. Sample and plan, 25c free. 12 articles worth $3. Alraid Scott, Cohoes, N. Y.

Free Booklet. Start little mail order business, Pier, Dept. 30A, 74 Cortlandt St., N. Y.

Miscellaneous

Get posted for Spring—Good prices paid for butterflies, insects. See Sinclair display advertisement, page 1518.

Send us your Metal Work. We are equipped to do metal stamping power press work, soldering and plating, etc. Estimates furnished. T. E. Bennett Co., 7 Beverly Street, Providence, R. I.

Polish Your Radio Sets with "Paraflex" Furniture Polish. Pints 60 cents, quarts $1.00, prepaid. Agents Wanted. Paraflex Polish Co., Canton, Mass.

Boost Radio—wear a pin or button, it shows you are progressive. Designs and estimates furnished by official club jewelers. The Rankin Co., Radio Dept. 1118-20 Chestnut St., Philadelphia, Pa.

Motorcycles—Bicycles

Don't buy a Bicycle Motor Attachment until you get our catalog and prices. Shaw Mfg. Co., Dept. 6, Galesburg, Kansas.

Used parts for all motorcycles cheap. State wants. Schuck Cycle Company, 1922 Westlake, Seattle, Wash.

News Correspondents

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566, St. Louis, Mo.

Office Devices

Save half on office machines, equipment, addressers, Multigraphs, Duplicators, Dictaphones. Pruitt Company, 172 North Wells, Chicago.

Old Money Wanted

$2 to $500 Each paid for hundreds of old or odd coins. Keep All Old Money, it may be very valuable. Send 10 cts. for new illustrated Coin Value Book, 4x6. Get posted. We pay cash. Clarke Coin Company, Ave. 80, LeRoy, N. Y.

Patent Attorneys

Millions spent annually for ideas! Hundreds now wanted! Patent yours and profit! Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. 301 Patent Dept., American Industries, Inc., Washington, D. C.

Patents. Send drawing or model for examination and report as to patentability. Advice and booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F Street, Washington, D. C.

Patent. Electrical cases a specialty. Pre-war charges. B. P. Fishburne, 340 McGill Bldg., Washington, D. C.

Patents Secured. .Prompt service. Avoid dangerous delays. Send for our "Record of Invention" form and Free Book telling How to Obtain a Patent. Send sketch or model for examination. Preliminary advice without charge. Highest references. Write today. J. L. Jackson & Co., 413 Ouray Bldg., Washington, D. C.

Herbert Jenner, Patent Attorney and Mechanical Expert, 624 F Street, Washington, D. C. I report if patent obtainable and exact cost. Send for circular.

Patents—Send for form "Evidence of Conception" to be signed and witnessed. Form fee schedule, information free. Lancaster and Allwine, 269 Ouray Bldg., Washington, D. C.

Patents—Write today for Free instruction book and Evidence of Conception blank. Send sketch or model for examination and opinion; strictly confidential. No delay in my offices; my reply special delivery. Reasonable terms. Personal attention. Clarence O'Brien, Registered Patent Lawyer, 751 Southern Building, Washington, D. C.

Patent application filed on partial payment plan. Trademarks, copyrights, etc. Milo B. Stevens and Company, 692 F Street, Washington, D. C. Established 1864.

Inventors: Protect your invention through A. M. Wilson, Inc., Washington, D. C. Over 20 years of efficient, expert, confidential service. Skilled in Radio-Electrical, Chemical and Mechanical fields. Our 1922 illustrated Booklet, giving much necessary and very useful information which every inventor should know, will be sent free upon request. Prompt and careful attention. Highest references. Moderate fees. Send sketch or model for our careful opinion and preliminary advice. Write today to A. M. Wilson, Inc., (Radio 3 ARH), 325 Victor Bldg., Washington, D. C. (Successor to business established in 1891 by A. M. Wilson.)

Free Personal Consultation by New York Patent Attorney. Benjamin Roman, 290 Broadway, N. Y.

Inventors! Patents procured, Trade-marks registered, prompt personal services, fees reasonable, request free "Inventor's Guide" giving detailed information. Franklin H. Hough, Inc., 927 Washington Loan & Trust Bldg., Washington, D. C.

Patents

Unpatented Ideas can be sold. I tell you how and help you make the sale. Particulars free. Write W. A. Greene, 106 The Atlantic, Washington, D. C.

Inventions Commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 278, St. Louis, Mo.

Personal

Lonesome? Make friends everywhere. Many wealthy, fascinating particulars for stamp. Smith, Box 3125 H, Portland, Oregon.

Exchange cheery letters with new friends! Send stamp. Betty Lee, Inc., 4254 Broadway, New York City.

Life Revelation with pictorial chart showing your character, talents, suitable occupation, affinity, etc. Send 10c, birthdate. St. Germain Society, Dept. 1133, Sharpsburg, Pa.

Sex Books—instructive, authoritative, profusely illustrated in natural colors, etc. Not the cheap sort. Large catalog free. E. Smetana Co., Owosso, Michigan.

Lonesome—Make Friends everywhere, many wealthy, fascinating particulars for stamp. Smith, Box 3125H, Portland, Ore.

Phonographic Supplies

Build Your Own Phonograph. Big saving. Pleasant, instructive work. Complete instructions, blue-prints, etc., absolutely free. Write today. Associated Phonograph Co., Dept. AP-13, Cincinnati, Ohio.

Printing

Everything Printed.—Long run specialists. Samples. Quality Printery, Marietta, Ohio.

250 Hammermill Bond Letterheads and Envelopes Printed with Your Name and Address $6.00. Packed in handsome, dustproof, separate compartment. Two sizes: Sheets 8½ x 11, Envelopes 3⅝ x 6½, or Sheets 7¼ x 10½, Envelopes 3⅞ x 7½. Write copy plainly, mention size, inclose your check or money order. Troik Printing Company, Established 1910, 1531 George Street, Chicago, Illinois.

Radio Equipment for Sale

Fifty complete hook-ups, from crystal set to latest Armstrong super-regenerative receiver, clearly illustrated with descriptions; 20 cts. Westbeard Engineers, 309 Canal St., New York.

Scenery to Rent

Settings for Opera, Plays, Minstrels. Plush Drops. Address Amelia Grain, Philadelphia.

Stamps and Coins

Stamps, 50 Varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10c. 50 different U. S. 25c; 1,000 mixed, 40c; 1,000 hinges, 10c. List free. C. Stegman, 5956 Cote Brilliante, St. Louis, Mo.

Telegraphy

Wanted—Young men and women to learn Morse and Wireless Telegraphy. Railroads and Wireless Companies in great need of operators. We teach you quickly, and procure position at big salaries. Great opportunities for advancement. All expenses low; can earn part. Write today for free catalog. School established 1874. Dodges Telegraph Institute, M Street, Valparaiso, Indiana.

Ventriloquism

Ventriloquism taught almost anyone at home. Small cost. Send 2c stamp today for particulars and proof. Geo. W. Smith, Room 543, 125 N. Jefferson, Peoria, Ill.

Wanted to Buy

Do You Want Extra Money—We will send you cash for any old Gold, Silver or Platinum Jewelry, and Diamonds, Silverware, discarded false teeth. Gather up the old scraps and send to us by registered mail. Highest prices guaranteed. If not satisfactory return our check and we return shipment at our expense. Meyer Jewelry Co., Suite 500 Boley Bldg., Kansas City, Mo.

Full value paid for old gold jewelry, watches, diamonds, crowns, bridges, dental gold, silver, platinum, gold or silver ore, magneto points, war savings stamps, old false teeth. Packages held 4 to 12 days and returned if our offer is not satisfactory. United States Smelting Works (The Old Reliable), 120 So. State St., Dept. 16, Chicago, Ill.

Cash for Old Gold, Platinum, Silver, Diamonds, Liberty Bonds, War, Thrift, Unused Postage Stamps, False Teeth, Magneto Points, Jobs, any valuables. Mail in today. Cash sent, return mail. Goods returned in ten days if you're not satisfied. Ohio Smelting Co., 304 Hippodrome Bldg., Cleveland, Ohio.

Wireless

Edison B Battery elements 8c pair. Alton Schlenker, 1806 Edmondson Ave., Baltimore, Md.

Send 50 cents for sample 22½ volt "B" Battery, retailing at $1.50. Fred Blethen, Houlton, Maine.

While they last—$45.00 Receiving Sets including Radiotron Detector $32.00. Two Step Amplifiers $22.00. Loudspeakers $12.00. Radiotron Detectors $4.25, Amplifiers, $5.75. Other bargains. QST Radio Service, Williamsport, Pa.

Variocouplers, with 14 taps and 3 in. dial $2.00; $25.00 DeForest sets with phones, $12.00; 1½ volt Westinghouse tubes $5.65, tube set $12.50; Detector unit $4.60; 43 plate condensers with 3 in. dial $2.90; Brandes superior phones $6.50. Max Bates, Astoria Ave. and Bay First Street, East Elmhurst, New York.

Stromberg-Carlson Phones. The professional headset at the amateur's price. Super-sensitive, comfortable, durable. Impedance correct for phone work with modern vacuum tubes. Equipped with five-foot polarity indicating, moisture-proof silk cords. A real radio headset for $7.50. Carrollton Radio Shop, Carrollton, Missouri.

February Special; our C3 receiver $37.50. Cheney Radio Co., Cheney, Kansas.

Sockets for WD-11 dry cell tubes 50c. Franklin Radio Mfg. Co., 711 Penn Ave., Wilkinsburg, Pa.

Penny Sale; 23 Plate Condenser $2.00, two for $2.01; 43 plate $3.50, two for $3.51. Gravenstede, 84 Hancock Ave., Jersey City, N. J.

Radio Sets complete (except phones) $2.00. Wizard Supply, 1068 Ave. C, Bayonne, N. J.

This is Real Service—Panels cut to order, smooth sawed edges. We cut them exactly to size and ship the same day your order is received. ¼-inch thick, 1½c per square inch; 5/16-inch thick, 2c; ⅜-inch thick, 3c; 7/16-inch thick, 3½c; 1/2-inch thick, 4c; why pay more? These radio panels are made of the highest grade black fibex. This material possesses high dielectric strength, is inexpensive, unbreakable and easy to work. Our special offer, radio panels 6x6x¼ inches, 50c; 6x12x¼ inches, $1. We also carry a complete stock of fiber rod and tubes, the real thing for electrical insulation, special prices quoted upon application. We pay postage. Radio Instrument & Panel Co., Box 75, Cicero, Ill.

Attention!—50 Vacuum tube hook-ups. The greatest collection of vacuum tube circuits ever brought under two covers at such insignificant cost. These diagrams will be found in the great "Rasco" catalog, which contains raw materials and parts in a greater profusion than any other catalog. 15c in stamps, or coin, will bring the catalog to you. Radio Specialty Co., 96-98 Park Place, N. Y.

Boys! Don't Overlook This. The "Rasco" Baby Detector. Greatest detector ever brought out with molded base. Fully adjustable. See former advertisements in this publication, or our catalog. Detector with Galena Crystal, complete 50c, the same detector with Radiocite Crystal, 75c prepaid. Send for yours today. Radio Specialty Company, 96-98 Park Place, New York City.

Dials 3 inch genuine hard rubber raised or depressed scale, white or gilt lettering drilled for ¼ and ⅜ inch shafts 60 cents each, 3 for $1.50 postpaid. No stamps. Radio Sales Co., Box 1144, Bethlehem, Pa.

Miller audiofrequency transformer eliminates howling. Entirely satisfactory on 3 stages. Price $5.00 postpaid anywhere in U. S. Radio Sales Co., Box 1144, Bethlehem, Pa.

Edison B Battery Units—One positive and one negative plate for 10c. 18 sets will make a 24-volt battery. Wilkinsburg Wireless Shop, 711 Penn Ave., Wilkinsburg, Pa.

Wireless—Continued

All Radio Experimenters League Members Wear a Radio Experimenters' Lapel Button. (See cut on page 1562, this issue). Be identified as an alert and progressive radio enthusiast. Join the Radio Experimenters' League conducted by amateurs for amateurs. Any owner of a Radio set is eligible for membership. Every member receives one of these 14K gold plated lapel buttons, also a membership card and private identification code number. All members of the league are entitled to a 10 per cent discount on any approved standard receiving or transmitting radio apparatus. You may also have your choice of any of the following: "Dopesheets" 1. Ten Super-Regenerative Circuit Diagrams every one designed by the famous Major Armstrong himself, together with a complete discussion of their operation by Major Armstrong reprinted by special permission from the Proceedings of the Institute of Radio Engineers. 2. Diagram of Armstrong Super Receiver with accurate panel layout, list of parts and where to get them, also three photos. This set actually works. 3. Diagram how to make a simple and inexpensive wave-trap to separate 360 and 400 meter waves and minimize interference. 4. Wiring diagram of the best transmitting set we have seen for C. W. voice or buzzer with accurate panel layout. 5. Details of new "Reflex" circuit showing how to get two stages Radio frequency and two stages Audio frequency using only two bulbs. We always have the facts on the latest developments. If you have any hard nuts to crack or questions to ask, shoot them in; we will send a "dopesheet". We old timers are sincerely glad to lend a hand wherever possible. This is one of the most valuable features of membership. Send your name today. Enrollment and registration fee 50c, includes button, membership card, 10 per cent discount privilege, and choice of any one of the above "Dopesheets". Other "dopesheets" in the above list or special "dopesheets" answering questions, 50c each. Radio Experimenters' League, 9-15 Clinton Street, Newark, N. J. More Radio clubs invited to affiliate. Limited number of tested W. T. 501 Peanut tubes on hand while supply lasts $2.00 each. Sockets 40c extra—adaptors 75c extra.

Edison Storage "B" Battery elements, 5c per pair, 18 will make one 22.5 volt Battery. Gilmans Battery Shop, Chelsea Sq., Chelsea, Mass.

$10.00 Variometers—$3.00 while they last, manufacturers' samples. Horton, Christie Street, Ridgefield Park, N. J.

$1.00 Buys one hundred super-sensitive galenas; each guaranteed to receive; Mountable size; Direct from most sensitive Galena mine in Southwest; Receipt furnished for cold mounting. Hutchinson & Co., Dallas, Texas.

Save Money Glass inclosed dustproof detectors $.50. Moulded Dial and Knob $.50. Socket $.50, Rheostats $.50 and many others. MacLeods, Box 249, Quincy, Mass.

Build your own electrolytic storage battery charger. Plates and complete instructions, $1.00. Descriptive Circular Free. Peerless Electrical Parts Co., 105 Harris Street, Rochester, N. Y.

Increase Your Crystal Receiving Range by using a "PT" Ultra-Sensitive Contact in your Crystal Detector. Junk your common detector spring or catwhisker. The "PT" locates a sensitive spot instantly; brings music and code in louder; and withstands hammer jolts without jarring out, even on galena. Price, with instructions, twenty-five cents. "PT" Crystal Contact Company, Box 1641, Boston, Massachusetts.

For Immediate Delivery—Tubes, Magnavox, Westinghouse Receiving Sets, Phones, Condensers, Rheostats, Variometers, Couplers, Panels, Transformers, V. T. Sockets, Dials, Switch Points, and full line of parts. R. B. Electric Co., Galva, Ill.

Ten percent discount on all standard radio goods. Prompt service. Superior two step Amplifier $25.00. QST Radio Service, Williamsport, Pa.

Wireless Course in 20 Lessons. By S. Gernsback, A. Lescarboura and H. W. Secor, E. E. Tells you everything you want to know about "Wireless"—theory, practice and history. A clear, concise course on every phase of this subject. 160 pages—350 illustrations, 30 tables. Stiff cloth cover, $1.75, postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York.

How to Make Wireless Receiving Apparatus. 100 pages—90 illustrations. Only strictly modern radio apparatus are described in this book and the illustrations and descriptions are so clear and simple that no trouble will be experienced in making the instruments. Paper covered, 35c, postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

How to Make Wireless Sending Apparatus. 100 pages—88 illustrations. Written and published entirely for the wireless enthusiast who wants to make his own radio apparatus. Contains more information on "how to make it" than any other book we know of. Paper bound 35c, postpaid. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

The How and Why of Radio Apparatus, by H. W. Secor, E. E. This newest book on radio matters fulfills a distinct gap in wireless literature in that, while the treatment is made as understandable and as free from mathematics as possible, it at the same time incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as teachers and students of the subject in general. A very broad field has been covered by the author, at the same time giving a great deal of information not found in other text books. If you are engaged in any branch of the Radio or allied arts at all you will surely need this latest contribution to radio literature, which is destined to be found on every radio man's book shelf before long. A glance at the following list of chapters gives but a very scant idea of the extensive and useful radio knowledge provided in its text: The Induction Coil; The Alternating Current Transformer; Radio Transmitting Condensers; The Spark Gaps; Radio-Transmitting Inductances; Radio Receiving Tuners; Radio Receiving Condensers; Detectors; Telephone Receivers; Radio Amplifiers; Construction of a Direct Reading Wavemeter and Measurement of Inductances; Appendix containing very useful tables, covering all subjects treated in this very unusual book. This newest of Radio Works, cloth bound in Vellum de Luxe, Gold Stamped and Hand Sewed, has 160 pages. Size of book, 6x9 inches. The How and Why of Radio Apparatus. Postpaid, $1.75. Experimenter Publishing Co., Book Dept., 53 Park Place, New York City.

Science and Invention Bound Volume No. 9, May 1921-April 1922; contains 1200 pages with over 1500 illustrations and over 700 articles by the foremost American and Foreign writers. We have also a limited amount of the following Bound Volumes of Science and Invention (Electrical Experimenter) Vol. No. 6—May 1918 to April 1919; Vol. No. 7—May 1919 to April 1920; Vol. No. 8—May 1920 to April 1921. Each volume bound in stiff board covered with green vellum and gold stamped. Price for volume No. 9—$2.25. Price for volume No. 6, 7 or 8—$2.00. All four volumes $7.00, sent express collect. Experimenter Publishing Co., 53 Park Place, New York City.

EVERY BOY WHO IS INTERESTED IN RADIO

CAN TAKE ADVANTAGE OF OUR SPECIAL OFFER

EVERY BOY HAS A FEW SPARE HOURS EACH WEEK and can easily obtain a few subscribers to PRACTICAL ELECTRICS.

On this page you will see the special rewards we will send you **for only one subscription.** You can easily earn every one of them. They will be sent you

ABSOLUTELY FREE

PRACTICAL ELECTRICS is the electrical magazine for everyone. It is the only electrical magazine a boy can understand. It has a regular department for beginners, but is just as interesting for the experimenter, the electrician, and the electrical engineer. There are articles each month by students, experimenters and famous electricians. The entire progress of the month in electrics is set forth in its pages.

PRACTICAL ELECTRICS is one of the most interesting electrical magazines published. It contains no long, dry technical articles. Every article is completely illustrated. There are hundreds of illustrations, plans, drawings, charts, etc.

On the opposite page you will find complete description of each reward.

PRACTICAL ELECTRICS is only $2.00 per year

[12 Numbers]

(Canada or foreign 50 cents additional)

EVERY BOY SHOULD HAVE IT!

All articles are written in plain, everyday language. If you need a sample copy to show we will send it free of cost.

SEE OPPOSITE PAGE FOR DESCRIPTIONS

OH BOYS! ABSOLUTELY FREE FOR A FEW HOURS' SPARE TIME WORK. READ OUR SPECIAL OFFER AND ACT AT ONCE.

Descriptive Details of Rewards

We will send you your choice of these rewards.
ONE REWARD FOR EACH SUBSCRIPTION for one year.

REWARD No. 1

RADIOGEM

A complete crystal Radio Receiving Set, will receive up to 25 miles. The outfit consists of all the necessary wire, contact points, detector mineral, catwhisker, tuning coil, instruction book, etc. When you have constructed the Radiogem, all you need is an aerial and a phone.

REWARD No. 2

MICROPHONE BUTTON

The button may be used to amplify Radio Signals by using it in a local circuit. It should be mounted on the diaphragm of a telephone receiver connected to the radio set and in circuit with a battery and a telephone induction coil. You can easily make a highly sensitive detectophone by using a Microphone Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument!

REWARD No. 3

EXPERIMENTAL ELECTRICITY COURSE IN 20 LESSONS

By S. Gernsback and H. W. Secor, E.E.

A Course on the theory and practice of Electricity for Experimenters. One of the most complete and comprehensive treatises of this special subject ever published. Written by the same authors as the famous "Wireless Course." The best electrical text book on the market. Size of books is 6 x 9 in. The book contains 128 pages, and more than 400 illustrations. Limp bound.

REWARD No. 4

Complete Patterns, Diagrams and Instructions How to Make Your Own
RADIOPHONE CRYSTAL SET
PATTERN No. 3

Consisting of a 4 page illustrated Direction pamphlet, size 8½ x 11½ inches; one blueprint pattern, size 16 x 12 inches. All contained in two-color printed envelope, 9 x 12 inches.

REWARD No. 5

Complete Patterns, Diagrams and Instructions How to Make Your Own
SHORT WAVE REGENERATIVE RADIOPHONE SET
PATTERN No. 1

Consisting of a five-page illustrated direction pamphlet, size 8½ x 11½ inches; one blueprint pattern, size 16 x 22 inches, and one blueprint pattern, size 17½ x 22 inches. All contained in a heavy two-color printed envelope, 9 x 12 inches.

REWARD No. 6

Complete Patterns, Diagrams and Instructions How to Make Your Own
DETECTOR AND AMPLIFIER RADIO UNITS
PATTERN No. 2

Consisting of a four-page illustrated direction pamphlet, size 8½ x 11½ inches; one blueprint pattern, size 16 x 18 inches, and one blueprint pattern, size 13½ x 15 inches. All contained in heavy, two-color printed envelope, size 9 x 12 inches.

REWARD No. 7

14 RADIO FORMULAE AND DIAGRAMS

All formulæ and diagrams are printed on heavy paper in black and blue; and contained in two-color printed envelope 9 x 12 inches.

REWARD No. 8

20 RADIOPHONE DIAGRAMS AND HOOK-UPS
Of Crystal and Audion Receiving Circuits, Amplifier Circuits, Regenerative Circuits, Sending Circuits with Key Chart of Symbols, and Pamphlet "HOW TO READ DIAGRAMS"

All 20 diagrams are printed on heavy paper, each sheet size, 8½ x 11½ inches, and together with Key Chart of Symbols and pamphlet, "How to Read Diagrams," are contained in a heavy two-color printed envelope, size 9 x 12 inches.

REWARD No. 9

WIRELESS COURSE IN 20 LESSONS

By S. Gernsback, A. Lescarboura, and H. W. Secor, E.E.
(10th Edition)

A Course that tells you everything you wish to know about "Wireless," starting in lesson No. 1 by explaining the Principles of Electricity. By simple, easy stages, this wonderful Course takes you into "Wireless" by the use of such simple language so skillfully used that of necessity you must understand every word.

Size of book is 7 x 10¼ inches, 160 pages, 350 illustrations, 30 tables, Limp bound.

REWARD No. 10

THE HOW AND WHY OF RADIO APPARATUS

By H. W. Secor, E.E.

This newest book on radio matters fills a distinct gap in wireless literature in that, while the treatment is made as understandable and as free from mathematics as possible, it at the same time, incorporates a wealth of technique and instruction for the Radio Amateur—the Radio Operator—the Installation and Designing Expert—as well as instruction for teachers and students of the subject in general.

160 pages, 6 x 9 inches. Limp bound.

REWARD No. 11

A THOUSAND AND ONE FORMULAS

By S. Gernsback

A laboratory hand book for the experimenter and for everyone who wishes to "do things." A book brimful with very important and priceless information, collected and selected for years. Invaluable for Students, Engineers, Physicians, Experimenters, etc.

It contains 160 pages. The paper has been especially selected to stand rough handling in laboratories. Size 6 x 9 inches. Limp bound.

REWARD No. 12

(All Three Books)

HOW TO MAKE WIRELESS RECEIVING APPARATUS

The 20 radio constructors who wrote the book know how articles should be made from simple materials.

Book has 100 pages, each 5 x 7 inches, 90 illustrations, many full pages, paper bound in two colors.

DESIGN AND CONSTRUCTION OF AUDION AMPLIFYNG TRANSFORMERS

Radio and Audio Frequency Type

This book will be of great interest to all radio amateurs. The transformers have never been described before in print.

Size, 5 x 7 inches. Contains many illustrations, diagrams and working data.

HOW TO MAKE WIRELESS SENDING APPARATUS

Contains information on how to make 30 different pieces of wireless sending apparatus from materials easily obtained.

Book has 100 pages (size 7 x 5 inches), 88 illustrations, paper cover printed in two colors.

PRACTICAL ELECTRICS CO., Inc., 53 Park Place, New York, N. Y.

GENTLEMEN:—Please send **PRACTICAL ELECTRICS** for one year (12 numbers) to each of the following addresses:

Name **Street Address** **City and State**

.....

.....

.....

.....

.....

Enclosed you will find.....subscriptions at $2.00 each, making the full sum of $..... (For each subscription to go to Canada or Foreign addresses 50 cents additional must be added.) Also please send me the Rewards (one for each subscription) numbered as follows:

.....

My Name Is .....Street .....

City .....State .....

"Rasco Has It"

Partial List of Goods Listed in "Rasco" Catalog No. 8

Detectors
Navy Knobs
Switch Handles
Pointers
Lock Nuts
Cord Tips
Copper Ribbon
Switches
Crystal Cups
Sliders
Litz Wire
Rotors
Panel Scales
Switch Levers
Condenser Plates
Carbon Balls
Audio-Frequency Transformers
Bakelon Panels
Name Plates
Crystals
Bornite
Silicon
Radiocite
Condensers
Ground Clamps
Plugs
Contact Arms
Aerial Connectors
Bus Bar Wire
Enameled Wire
Transformer Coils
Copper Strip
Flexible Cord
Knobs
Panel Knobs
Key Knobs
Binding Posts
Lock Posts
Machine Screws
Switch Stops
Telegraph Key Knobs
Hard Rubber Binding Posts
Nickel-plated Switch Points
Zinc Spark Gap Ends
Panel Switches
Mounted Crystals
Tin Foil
Rheostat Windings
Spring Clips
Antenna Connectors
Lock Fork
Spacing Washers
Carbon Grains
Blow Torches
Minerals
Copper Pyrites
Iron Pyrites
Soft Metal (Hugonium)
Threaded Brass Rod
Cord Tip Jacks
Vacuum Tube Sockets
Mica Diaphragms
Radio Cement
Choke Coils
Magnet Wire
Brass Rod
Grid Leak Condensers
Phone Cords
Metal Dials
Universal Panel Bearing Handles
Switch Knobs
Potentiometer Windings
Binding Post Name Plates
Spaghetti-Insulating Tubing
Radio Frequency Transformers
Instrument Posts
Hexagon Nuts
Spring Binding Posts
Switch Studs
Cap Nuts
Brass Lugs
Copper Lugs
Dials
Lubricated Switches
Panel Switch Levers
Mica
Vario-Coupler Rotor
Battery Switches
Switch Blades
Selenium
Diaphragms
Carbon Buttons
Transformer Stampings
Solderall
Galena
Zincite
Mineral Sets
Brass Washers
Copper Braid
Jacks
Rheostat Windings
Vacuum Tube Fuses
Lock Washers
Dial Verniers
Resistances
Silk Wire
Honeycomb Coils
Phone Condensers
Separable Cord Tips
Composition Dials
Plugs
Aerial Insulators
Phones

ILLUSTRATION FULL SIZE

300 Illustrations

This catalog contains over three hundred illustrations. On account of its very great cost, it can not be distributed free of charge.

Mailed only on receipt of 15c. in stamps or coin

"Build Your Own!"

THE Radio Specialty Company, "RASCO" for short, is probably the most unique radio parts supply house in the United States, if not in the world today. This Company makes a specialty of **SMALL ORDERS.** No order can be too small to get immediate and prompt attention, for the simple reason that most of our orders are small.

The reputation of this Company was built solely on service. Ask any of your acquaintances what they think of "RASCO" goods, "RASCO" service, "RASCO" promptness! Thousands of unsolicited testimonials on file prove that we serve the public best!

Many houses claim that their orders are shipped within twenty-four hours. A year's record in our Order Department actually shows that over 99% of our orders leave within **twelve hours** after receipt. We invite you to try "RASCO" service on a 50c order .**MAKE US PROVE WHAT WE SAY.**

Sixty-eight per cent of all of our customers come back for more goods after they have tried our service once. The reason is very simple, as we specialize in very small orders. We could not stay in business if we had to look for new customers continually.

"RASCO" SERVICE IS WHAT COUNTS!

"Rasco" Catalog No. 8

The new "RASCO" catalog, No. 8, will prove a revelation to the man who "builds his own." In this catalog are listed more parts and more items than you have previously thought possible to obtain.

The new "RASCO" catalog contains over 500 different radio items, and has been greatly enlarged over the preceding one. IT NOW CONTAINS 64 PAGES, INSTEAD OF 40.

Price Reductions

Many items have been reduced to give our customers the benefit of the lower prices that enlarged production makes possible.

Factories in Brooklyn, N.Y., and Elkridge, Md.

These two factories, where our screw machine work, our stamping and our composition work is turned out, make it possible for us to offer the very lowest prices in the country.

75 Vacuum Tube Hook-Ups!

These hook-ups of ALL important vacuum tube connections are given in clear diagrams with complete explanations. This is the one and only catalog containing such a wealth of information on all Vacuum Tube sets, giving all the correct values of all the elements, so that any amateur can readily hook up a set with the instructions furnished.

All Armstrong Circuits: These important circuits are explained clearly, all values having been given, leaving out nothing that could puzzle you. Just to name a few of the Vacuum Tube circuits: The V.T. as a detector and one-step amplifier; regenerative circuit; DeForest ultraudion; V.T. to receive undamped and spark signals; Armstrong circuits; one-step radio frequency amplfiier and detector; three stage audio-frequency amplifier; short wave regenerative circuits; V.T. radio telephone; 4-stage radio frequency amplifiers; radio and audio frequency amplifier, inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; combination V.T. detector one stage amplifier; two stage radio frequency amplifier and detector with feedback coupling (regenerative); regenerative receiver, using single spider web coil; Armstrong super-regenerative circuit; two stage radio frequency amplifier coupled to a two-circuit tuner, using two-slide tuner regenerative receiver; two stage audio-frequency amplifier, using crystal or V.T.; one stage radio frequency detector, two stages audio-frequency with feed-back coupling to first tube; power amplifier with loud speaker; regenerative receiver and one stage amplifier for DX work; one stage radio frequency detector with feed-back coupling; very sensitive circuit with two stages of radio frequency and regenerative detector; one to ten mile radiophone transmitter; three stages radio frequency, two stages audio-frequency, loop reception; crystal detector with rectification; one tube super-regenerative receiver: short wave regenerative receiver with two variocouplers, capacity-coupled tuner; trap circuit to eliminate interference; selective circuit to eliminate interference.

If you were to buy a book containing all of these 75 Hook-ups you would have to spend from $3 to $7.00 to secure the same information.

Radio Specialty Co

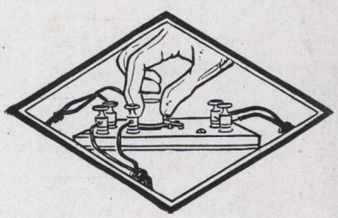
This business was originated with the sole purpose to cater to the amateur who has small orders. ALL OF OUR ORDERS ARE SMALL and that is why your small order will never be sidetracked by us. A trial order will make you a life customer. "We can only stick you once." Try us with a 50c order.

ALL GOODS PREPAID

98 PARK PLACE, NEW YORK CITY

DEALERS
Get Our Special Proposition

Factories
Brooklyn, N. Y.—Elkridge, Md.



COMPARE THE *Herald* BY SWITCH TEST

LOUD CLAIMS for Loud Speakers prove nothing. The proof of the Speaker is in the hearing.

Ask your radio dealer to let you hear the Herald Switch Test. He will shift the same broadcasting from one speaker to another.

Compare the tone, quality, clarity, purity and depth of the HERALD with all other Speakers and judge for yourself.

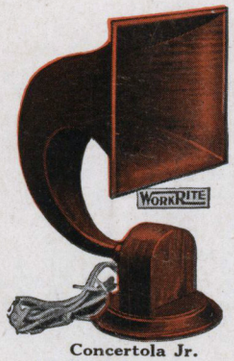
If your dealer is not equipped to give this test, ask him to write us and our Demonstration Department will stage the Herald Switch Test in his store.

The HERALD operates on any voltage from 45 up, without an external or "A" battery. Merely attach in place of a head-phone.

Hear the HERALD before you decide. The price is $40.

Herald

Herald Laboratories Inc. **74 Lafayette Street, New York**



Concertola Jr.

WORKRITE REDUCES PRICES

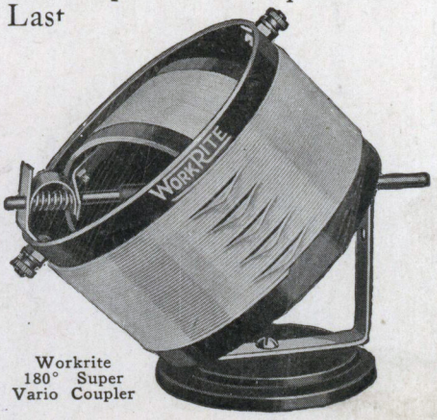
GOOD NEWS FOR RADIO FANS

Here is the opportunity for you to get WorkRite Variometers and Variocouplers at prices less than those asked for inferior unknown instruments. The new WorkRite Super Variometer and WorkRite Super 180° Super Variocoupler with 12 taps and wound with green silk are now $3.50 each. Last spring they sold for $6.00.

Don't wait any longer. Equip your set with WorkRite parts at once. Remember the prices.

WorkRite Super Variometer .....Each
WorkRite 180° Super Variocoupler.....Each

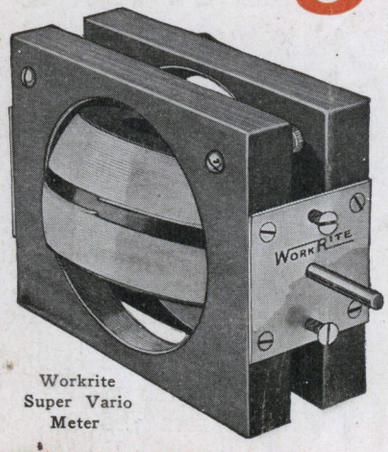
$3.50



Workrite 180° Super Vario Coupler

FAITH IN YOU

is what caused us to make this big reduction in prices. In order to maintain it we must increase our sales enormously. We must sell 10 instruments where we previously sold one. But we know that you will justify us in this faith.



Workrite Super Vario Meter

Concertola, Sr.

WORKRITE CONCERTOLAS

These Loud Speakers are pleasing thousands of radio fans. Read the following letter received from one of them.

"Regarding the WorkRite Concertola Jr. received some time ago I wish to advise that it is the best $12.00 worth I have ever bought. Stations in the following cities have come in very QSA, even on warm nights, with the Concertola: St. Louis, Louisville, Pittsburgh, Detroit, Schenectady, Dallas, Tex., Fort Worth, Tex., Atlanta, Ga., Havana, Cuba, Charlotte, N. C., Chicago, Cleveland and many others.

These stations can be heard all over the room with ease on warm nights, and all over the house on colder nights. With ever a good word for the Concertola I am,

EARL E. DAESCH, 1103 Columbia Terrace, Parkersburg, W. Va.

WorkRite Concertolas cannot be excelled for the money. Fine finish—clear tone—beautiful design. These instruments are designed for use with vacuum tube sets having two-stage amplification.

Free Trial! If after you have used one of these instruments three days you do not find that it will satisfactorily amplify your concerts, you may return it and we will refund your money.

WorkRite Concertola Jr. with Cord and Phone Unit $12.00
WorkRite Concertola Sr. with Cord and Phone Unit $24.00

Complete List of WORKRITE PRODUCTS

WorkRite Super Variometer. Very sensitive and sharp tuning. There is no better.
Price $3.50

WorkRite 180° Super Variocoupler. Tunes twice as sharp as the ordinary 90° coupler.
Price $3.50

WorkRite Super Vernier Rheostat. 50,000 possible adjustments. You need one.
Price $1.50

WorkRite E-Z-Tune Dial. Has a grip on the rim where you can grasp it for fine tuning.
Price ..... .75

WorkRite Switch Set. Complete with switch arm, points and stops made to work together.
Price ..... .80

WorkRite Concert Headphone. Strong and reliable. Compare it with any on the market.
Price $8.50

WorkRite Type "A" Hydrometer. Get one to use on your "A" Battery. It may save you many dollars.
Price $1.00

WorkRite Concertolas. Loud Speakers of "WorkRite" quality. Remarkably clear tone. WorkRite Concertola Jr. $12.00
WorkRite Concertola Sr. $24.00

THE WORKRITE MANUFACTURING CO.

5545 EUCLID AVENUE, CLEVELAND, OHIO

(Branch Office, 2204 Michigan Ave., Chicago)